JANUARY
1960

PRICE 75 CENTS

ELECTRICAL CONSTRUCTION AND MAINTENANCE

WITH ELECTRICAL CONTRACTING

HAROLD A. WEBSTER
of T. Frederick Jackson, Inc., New York electrical contractors, is new President of the National Electrical Contractors Association.

OUTLOOK FOR 1960

Analysing the market for electrical construction, installation and maintenance activity for the year ahead.

THE TRUTH ABOUT LONG-LIFE LAMPS

A special report from laboratory tests compares "10,000-hour" with "extended service" and "standard" incandescent lamps.

National Electrical Week
February 7 to 13

A McGRAW-HILL PUBLICATION | 59TH YEAR

THE V IS THE THING

25% UPLIGHT

BETTER LIGHTING QUALITY
BETTER WORKING ATMOSPHERE
10% BETTER MAINTENANCE

GUTH WYTELINER INDUSTRIALS

Their V-shaped center reflector can't trap dirt or dust. Therefore, it stays clean far longer than flat-center reflector units.

Guth 25% Uplight fixtures produce powerful downlighting and afford 27° normal shielding. They wash away gloom and overhead shadows, improve eye comfort and working conditions . . . assure maximum lighting efficiency, plus less maintenance, even under the poorest area conditions.

Units available for 430, 800 or 1500 M. A. operation.

WRITE FOR NEW INDUSTRIAL BROCHURE NOW!

Guth LIGHTING

THE EDWIN F. GUTH CO.
2615 Washington Blvd.
St. Louis 3, Mo

A GUTH EXCLUSIVE!
KOLORKODED
INDUSTRIAL FIXTURES
WITH BUILT-IN TRAFFIC LIGHTS

. . . red, green and yellow "signals" to direct traffic, protect workers, identify plant or storage areas.

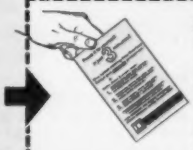
ONLY SQUARE D STARTERS WITH ONE-PIECE OVERLOAD RELAYS GIVE ABSOLUTE PROTECTION!

• Only Square D makes thermal overload relays with 1-piece construction—and only with 1-piece construction can you *know* you've installed the heater correctly. Square D 1-piece overload relays can be installed only one way. They are factory-assembled, individually tested and calibrated, completely tamper-proof. Repeated tripping will not affect accuracy.

You *pay* for overload protection—be sure you *get* it. Insist on Square D 1-piece overload relays for *absolute* protection.

EXCLUSIVE— 1-piece Overload Relay for *ABSOLUTE* Protection!

Mail coupon today for simple "jig-saw" demonstrator—see why only Square D gives absolute protection



Square D Company
Department SA-221
4041 North Richards Street
Milwaukee 12, Wisconsin

Please send me information on Square D magnetic starters, along with your simple 3-minute "jig-saw" demonstrator

NAME_____

COMPANY_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

SQUARE D COMPANY

wherever electricity is distributed and controlled

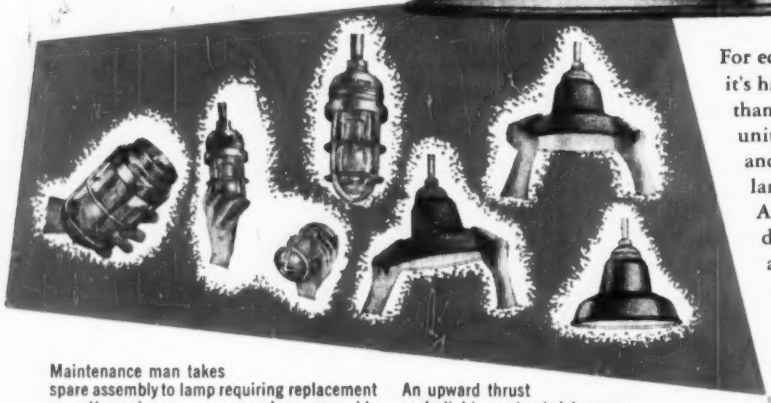
APPLETON V-51 SERIES CONVERTIBLE VAPORTIGHT FIXTURES

Require only seconds

to relamp or convert!

One trip up the ladder, a few quick twists of the wrist, and relamping or wattage conversion is done! V-51 reflectors with integral neoprene ring adapt perfectly to the grooved unilet . . . permit instantaneous substitution of reflectors.

U. S. Pat. 2,749,433
2,749,435 2,715,214
Canada Pat. 531,655
511,696



For economical service and maintenance, it's hard to find anything more practical than Appleton's V-51 Series exclusive unit assembly (adapter, receptacle, globe, and guard). Shock absorbing socket cuts lamp replacement costs. Try the Appleton V-51 Series standard or shallow dome, deep bowl, or angle type reflectors and 100 W and 150/200 W vaportight unit assemblies in your plant today. Available in a variety of hub sizes in pendent, ceiling, or bracket type fixtures for every kind of installation.

Maintenance man takes spare assembly to lamp requiring replacement or wattage change . . . removes lamp assembly . . . screws fresh unit in place and the job is done! Higher wattages of 150/200 are interchangeable with 100 watt unit and can be used in same unilet body. (Die-cast aluminum guard turns counter clockwise to act as a tool for easy removal in relamping).

An upward thrust and slight quarter twist engages neoprene ring with the groove in the unilet and snaps the reflector in position. Entire operation of removing lamp, inserting new unilet, and positioning of reflector requires no special tools . . . no set screws . . . no small parts to juggle. Absolute simplicity!

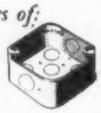
Sold Through Franchised Distributors Only

APPLETON ELECTRIC COMPANY
1704 Wellington Avenue • Chicago 13, Illinois

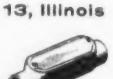
Rely on **APPLETON**® *. . . the Standard for Better Wiring®*

Also Manufacturers of:


"ST" Series Connectors


Outlet Boxes


Explosion-Proof Fixtures


Malleable Iron Unilets & Covers


Automatic Reelites

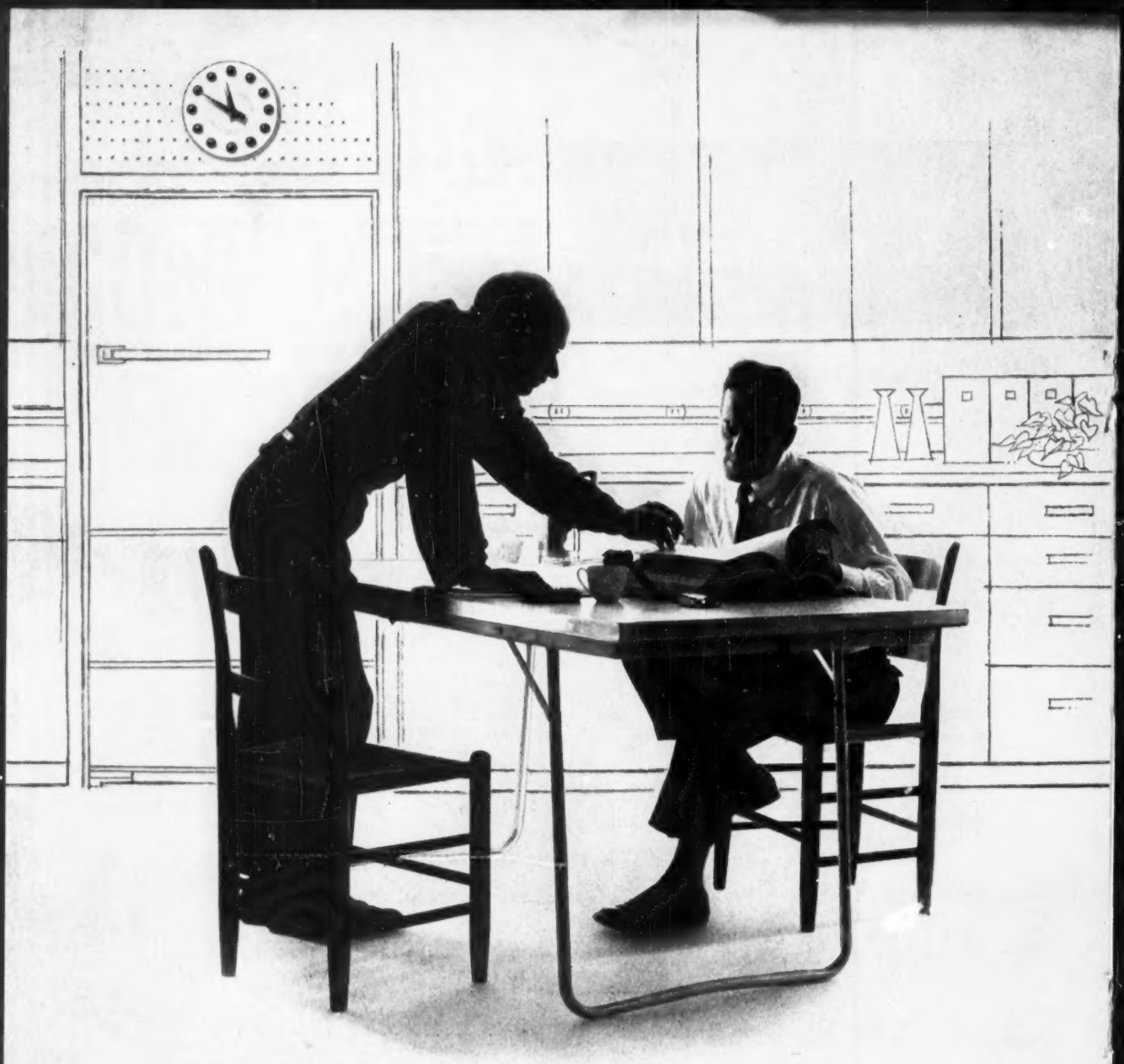
ELECTRICAL CONSTRUCTION AND MAINTENANCE

with which is consolidated Electrical Contracting, The Electragist and Electrical Record — Established 1901

Published for electrical contractors, electrical departments in industry, engineers, consultants, inspectors and motor shops. Covering engineering, installation, repair, maintenance and management in the field of electrical construction and maintenance.

59TH YEAR • JANUARY 1960

MORE



"This is going to save a lot of money!"

Time and again, an electrical contractor and his Graybar man, thumbing the specs and combing the catalog over midnight coffee, come up with important savings.

It wouldn't be possible without Graybar's complete in-stock lines . . . and unless the Graybar man knew literally thousands of electrical items from first hand experience.

Reducing your costs through efficient selection of equipment is just one of three direct benefits you get from Graybar. The other two: your Graybar service team of Field Salesman, Inside Salesman, Counterman and Specialists also helps *speed your work* . . . and *build your business.*

Running into cost problems? Call your Graybar man now.

918

Graybar Service includes: Objective recommendations. On-the-job technical help. Most complete lines. Planned stocks to meet your needs. Expert counter service. Speedy handling of will-calls.

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420 LEXINGTON AVENUE, NEW YORK 17, N. Y. • OFFICES IN OVER 130 PRINCIPAL CITIES

Everything Electrical GraybaR ELECTRIC COMPANY

ELECTRICAL CONSTRUCTION AND MAINTENANCE

JANUARY • 1960 *continued*

Vol. 59, No. 1 ELECTRICAL CONSTRUCTION and MAINTENANCE JANUARY 1960

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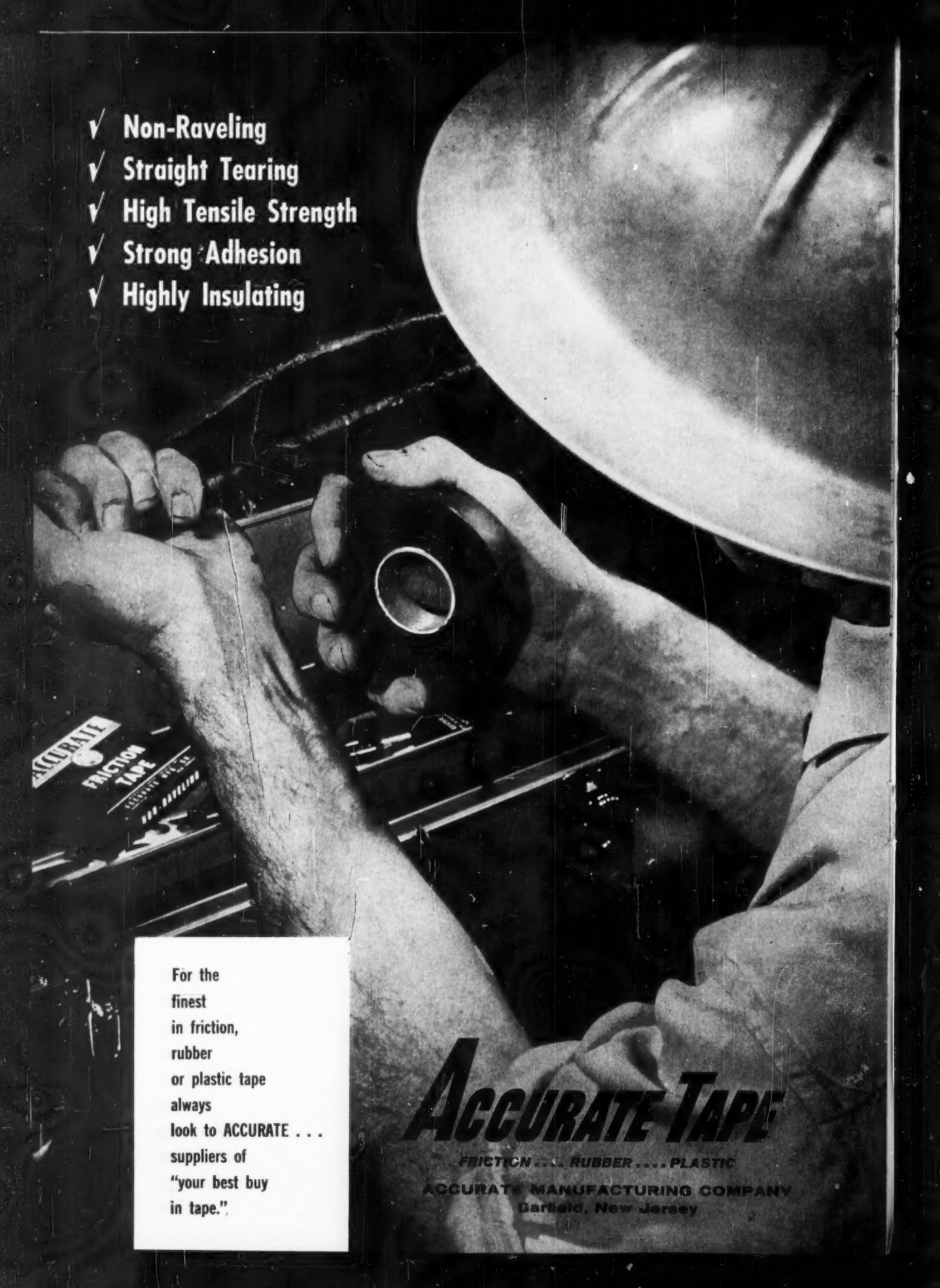
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TAPE
For the
finest
in friction,
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in tape."
ACCURATE TAPE
FRICTION . . . . RUBBER . . . . PLASTIC
ACCURATE MANUFACTURING COMPANY
Garfield, New Jersey

Washington Report

JANUARY • 1960

Business will be bolstered by favorable economic conditions during the first half of 1960, and a high rate of activity seems assured throughout the year, assuming that the steel strike is not resumed. Steel production should continue to expand, auto production is expected to set a new three-month's record, building construction overall is scheduled for a continuing climb, retail sales are at an all-time peak—should continue to expand, personal income is at an all-time high, and employment remains at a high level.

Negative influences in the economic outlook include a predicted decline in housing starts, continued tight credit, an unbalanced Federal budget for fiscal 1960 ending next June 30, continued inflationary pressures.

Private homebuilding last year totaled over 1,325,000 units, according to an early year-end estimate, and nearly equal to the all-time record of 1950. But with mortgage money scarce a decline to between 1.1 million and 1.2 million units is predicted for 1960.

Housing starts in November dropped to 92,300 from 105,100 starts in October, but this decline was considered less than seasonal. A revival of big-scale federal lending in the mortgage market is being considered in Congressional circles to stimulate private housing starts. The Administration, however, will oppose any action, on the basis that housing needs no push that might contribute to new inflationary pressures.

An increase of 2% in new construction spending is forecast for 1960 by Business and Defense Services Administration, Dept. of Commerce. This increase totals about $1.3 billion, would result in total construction spending of $55.3 billion this year. The important angle, from an electrical construction standpoint, is the predicted mix. Housing, which carries a small percentage of electrical work, may decline by about 3%, dollarwise, or up to 10% in number of starts. On the other hand, healthy increases over 1959 construction are predicted in industrial, commercial and institutional work.

Capital spending for new plant and equipment is also heading back toward its peak, with a predicted 10% rise this year over 1959.

Highway construction has been slowed on account of financing, will probably result in a new demand this year for another boost in federal tax on gasoline.

Cost-of-Living is inching upwards slowly, as November 1959 index rose to 125.6% of 1947-49 average, up 0.1% from October. This was the sixth new price high point in the last seven months, and compares with 123.9% for November 1958.

Steel mills last month set a new weekly production record of 2,732,000 tons, with mills operating at 96.5% of capacity. Other economic indicators include: industrial production in November was 148% of 1947-49 average; major electrical appliance sales last year topped 1958 sales by 17% and a 3% increase over 1959 is forecast for this year; employment at mid-November totaled 65,640,000, while unemployment rose to only 3,670,000, or 5.6% of work force; personal income in November inched up again to a record annual rate of $384.8 billion, topping the previous high of $383.8 billion in June 1959 just previous to the steel strike; total consumer credit last October was $49.8 billion, compared with $43.6 billion a year earlier, and consisted of a $38.4 billion for installment credit, $11.4 billion for non-installment credit.

Sidelights

What's Ahead

Department of Commerce statisticians see a healthy construction year ahead; some declines, notably in residential work; some advances, particularly in industrial work. The year should wind up a little better over all than last. For the electrical industry, the picture is brighter as the advancing categories are those with relatively high percentages of electrical work. For the Commerce predictions on construction activity and our own estimates of electrical construction activity see "Outlook for 1960" beginning on page 75.

Long-life Lamps

For many months, long-life incandescent lamps have been advertised and sold by metropolitan department stores and other retailers. Claiming and sometimes guaranteeing 10,000-hour life or five years service in home-lighting for these lamps, the advertising has aroused wide public interest.

After inquiries from readers, many with responsibility for maintaining thousands of lighting fixtures, we decided to find the facts and present a full report from which our readers could readily compare the performance of long-life lamps with conventional lamps of shorter average life.

To exclude any possibility of bias in performance data selection, we bought a broad sampling of lamps at retail and submitted them to a leading testing laboratory which provided us with exact performance values for each lamp. The reported values, averaged by Associate Editor Berlon C. Cooper, provide the basic data for his detailed comparative analysis "The Truth About Long-Life Lamps" beginning on page 78.

NECA President

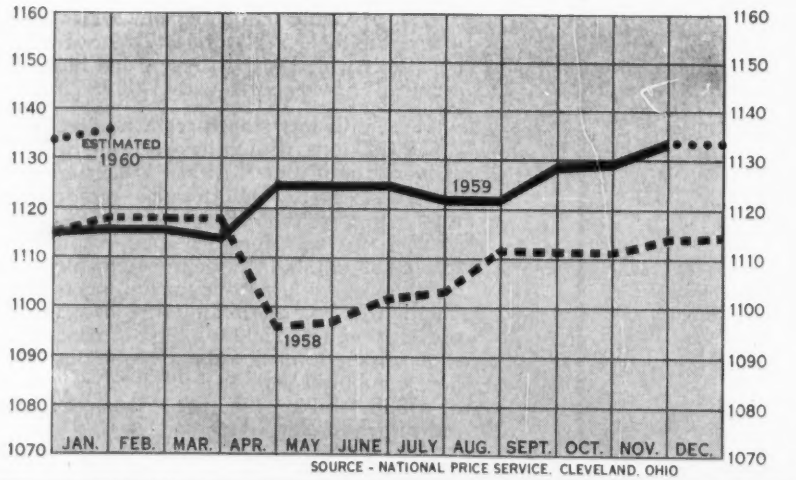
Harold A. Webster (cover photo) of T. Frederick Jackson, Inc., electrical contractors of New York, N. Y., is the new president of the National Electrical Contractors Association for 1960 and 1961. Mr. Webster was vice-president for District 1 and a member of the Executive Committee of NECA.

National Electrical Week

The week of the birthday anniversary of Thomas A. Edison, February 7-13, will be observed throughout the United States as National Electrical Week. Chairman of the NEW Committee is N. J. MacDonald, president of Thomas & Betts Company of Elizabeth, N. J., and president of the National Electrical Manufacturers Association. NEW is a broad umbrella activity in which all branches of the electrical industry can participate. Promotional materials for electrical contractors including buttons, bumper strips, posters, mats and speech material are available at a nominal cost from the NEW Committee, Suite 306, 407 N. 8th St., St. Louis 1, Mo.

ELECTRICAL MATERIALS COST INDEX

BASE LINE (1000) REPRESENTS COSTS OF TYPICAL ASSORTMENT OF MATERIALS FOR A SELECTED JOB AS OF NOVEMBER 1, 1951. INDEX POINTS REPRESENT THE VARIATION OF THESE SAME MATERIAL COSTS AS OF THE FIRST OF EACH MONTH.



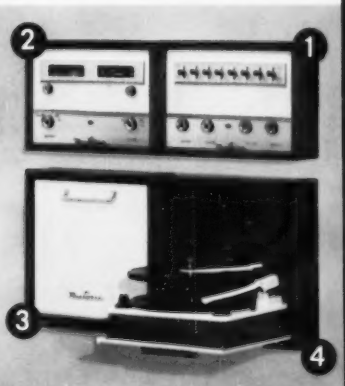
SOURCE - NATIONAL PRICE SERVICE, CLEVELAND, OHIO

NEW

NUTONE BUILT-IN STEREO COMBINED WITH AM & FM RADIO, INTERCOM, HIGH FIDELITY MUSIC

Now you can offer STEREO through the entire house, not just in a single room. No costly console cabinets. . . No wasted floor space! Everything is built-in. Fits standard 4" studding.

Arrange the components you want to suit your own plans. The moderate cost will surprise you . . far less than the same units in cabinets.



It's new . . it's beautiful . . it's Stereo . . plus the step-saving convenience of Intercom . . plus am-fm Radio . . plus High-Fidelity music . . combined in the NuTone Built-In Stereo System.

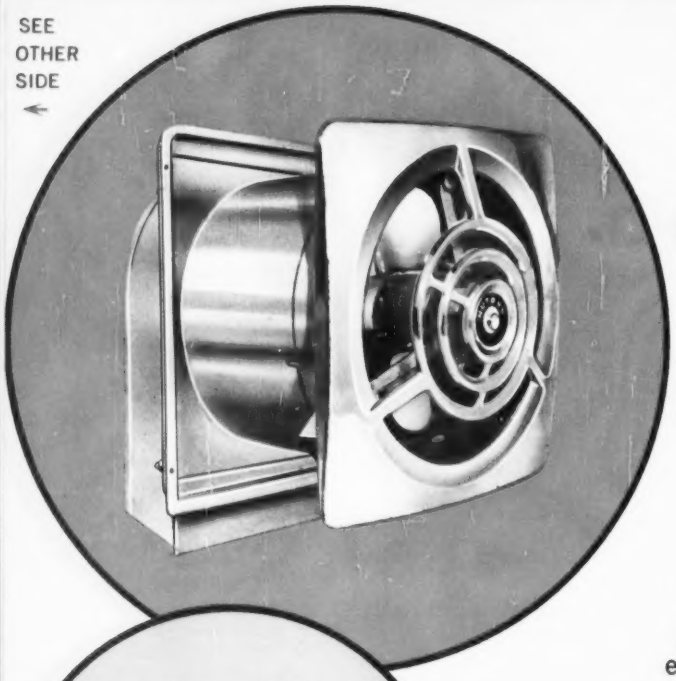
Built-In Wall Speakers offer the finest tone because no cabinet can match their rigidity and size. The complete system is engineered for easy operation.

Here is an exciting idea for your 1960 homes . . a real luxury . . which adds many times its cost to the home value.

1. **Dual Chassis Amplifier . . . also contains Intercom Controls..**
2. **AM-FM Radio Tuner . . . receives two programs at the same time.**
3. **Built-in Cabinet for Record Storage . . or Cartridge Tape-Deck..**
4. **Fold-into-wall Record Changer. 4 speeds. Automatic shut-off.**
5. **Wall Speakers with controls for Intercom . . Balance . . Volume.**
6. **System includes Door speaker, Remote controls, Outdoor Speakers.**

SEE OTHER SIDE ⟶

SEE OTHER SIDE ←

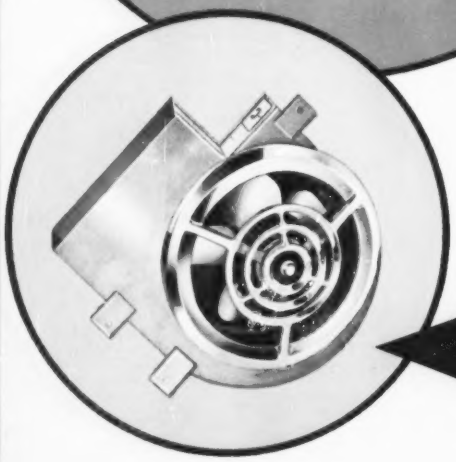


NUTONE'S *New* *Jet-Power* FANS

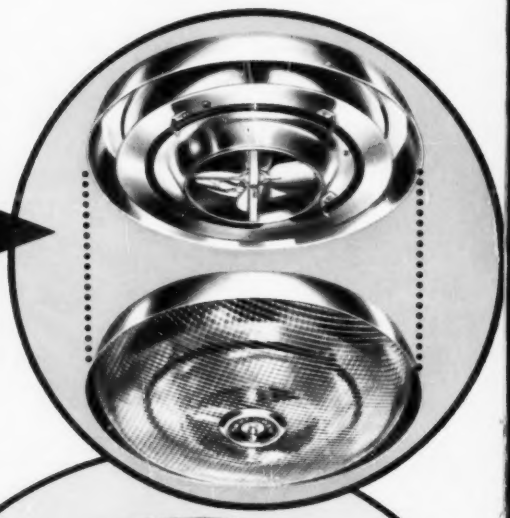
CRISP, ULTRA-MODERN STYLING!

NuTone offers America's Newest Exhaust Fans. Completely redesigned for beauty and luxury . . engineered for power and performance. Changed in every way — except the price is the same!

Sparkling anodized grilles for the "Jet-Look". Improved motors and blades for "Jet-Power". Nine new models for wall and ceiling . . Pull-Chain or Automatic . . Horizontal or Vertical Discharge . . All NuTone Exhaust Fans meet or exceed FHA Minimum Property Standards. (MPS.)



NuTone

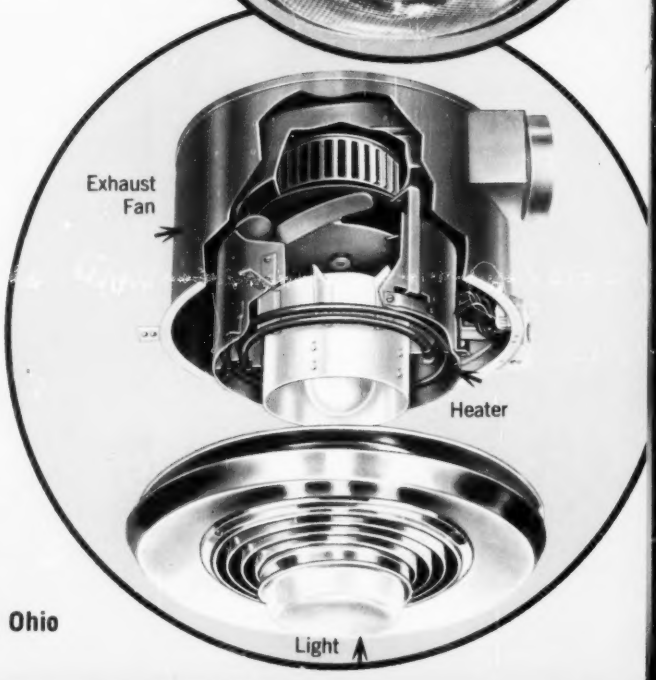


NUTONE'S *New* *Ceiling* HEATERS

"BUILT-IN" OR SURFACE MOUNTED

New slim-line styling that hugs the ceiling! Your choice of surface-mounted Radiant Type with air-cooled housing . . or the Exclusive Heat-A-Ventlite . . combining a Heater plus an Exhaust Fan plus Ceiling Light — to save space.

NuTone Ceiling Heaters have armored elements for longer life and trouble-free performance. Moderate in Cost — Easy to Install.



NEW DELUXE 1960 Catalogs in BINDER

Write to NUTONE, INC., Dept. AB-1, Cincinnati 27, Ohio

Don't Price Yourself Out of the PLUS Features You Get with SQUARE D CONTROL CENTERS

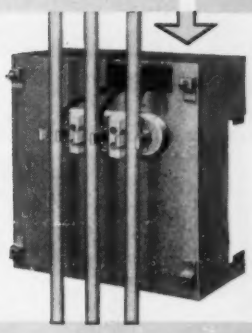
Industrial construction
All outer surfaces and structural parts are 12 gauge steel. Corner channels, cross members and doors are *formed* on special dies for maximum rigidity. Rust-resisting finish—phosphatized plus *baked* enamel.

Saves space
Unit heights in *3-inch* increments—an exclusive Square D advantage which permits use of units with minimum heights, eliminates the wasted space typical of modular systems.

Built-in safety
Units are metal-enclosed to confine damage should a fault occur. Unit side plates are permanently attached—can't be accidentally discarded. Switch-type units have visible blade disconnects for added safety.

Extra control flexibility
A variety of removable panels accommodates up to four oil-tight push buttons and pilot lights.

Tubular vertical buses
Another Square D "exclusive"—inherently stronger—greater cooling surface. Extra-wide spacing between phases gives added "breakdown" protection. Plug-in stabs are silver-plated copper backed by steel springs—give high pressure low resistance contact at all times.



Liberal wiring space
Wiring channels are *large and accessible*. No wire fishing through narrow passageways—wires can be laid in position—less costly installation.

GET THE COMPLETE STORY

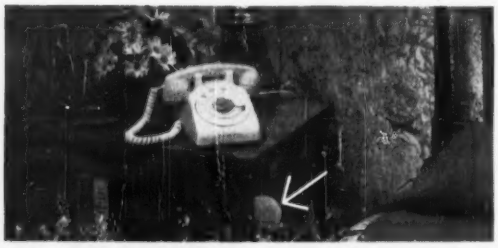
BULLETIN SM-244 gives detailed information on all of the "plus" advantages you get when you specify Square D motor control centers. Send for a copy. Square D Company, 4041 North Richards St., Milwaukee 12, Wis.

SQUARE D COMPANY

wherever electricity is distributed and controlled

This is National Homes' 1960 "Lorraine" model...

Designed for easier living...with telephone planning!



National Homes' Regency Line will feature provisions for as many as *eight* telephone outlets per home—permitting extension phones in all key working, playing and sleeping areas. Above are the bedroom and kitchen-dining telephone locations in the "Lorraine" model.

The nation's largest builder of homes—National Homes Corporation—is adding *telephone convenience* to the many modern features it will offer buyers this year.

National Homes' entire Regency Line, including the "Lorraine" model shown here, will contain provisions for multiple built-in telephone outlets.

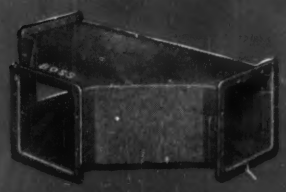
As homeowners require new extension phones, they can have quick, trouble-free installations with wiring neatly hidden inside walls. Such telephone planning preserves the beauty of room interiors and offers the ultimate in telephone-service flexibility and convenience.

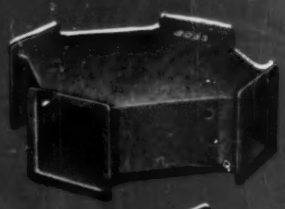
Are you telephone planning *your* homes? Builders everywhere are finding it gives them a real sales advantage. Consult your local Telephone Business Office for complete details. Also, see Sweet's Light Construction File, 11c/Be.

BELL TELEPHONE SYSTEM

Visit booths 15 and 16, Conrad Hilton, Chicago, NAHB Convention, January 17-21, 1960 – for real money-making telephone tips.

BOSS . . . COMPLETE LINE OF ELECTRICAL ENCLOSURES





BOSS J.I.C. Wireway and Fittings

Flanged Hinged Cover Wireway & Fittings

Flangeless Screw Cover Wireway & Fittings

Flangeless Hinged Cover Lay-In Wireway & Fittings

"The Line of Least Resistance"

BOSS

You can always be sure of *excellent quality* and *prompt delivery* on stock or "specials" with the complete line of BOSS Boxes, Wireway and Fittings.

Job-engineered for quick, easy installations, BOSS enclosures are code gauge steel, have smooth corners, with firm but easy knockouts. All units are *UL approved.* Finished in durable gray baked enamel.

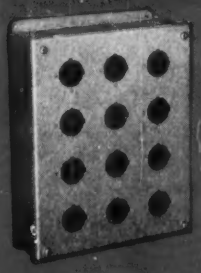
BOSS now also offers you new *Oil Tight* Push Button Enclosures for excellent protection against oil, dirt and liquids.

Write for Catalog on the complete line of BOSS Electrical Enclosures.

Sold thru leading distributors everywhere.

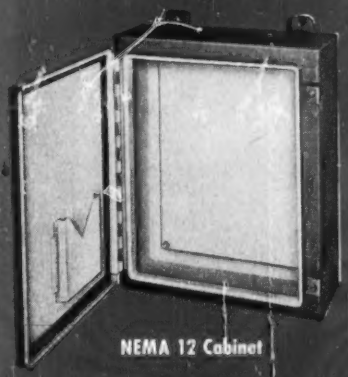
J. I. C. Box with Panel

Type "A" Box

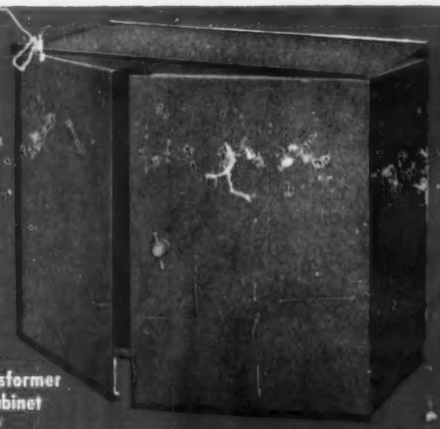


Oil Tight Pushbutton Enclosure

Screw Cover Pull Box



NEMA 12 Cabinet



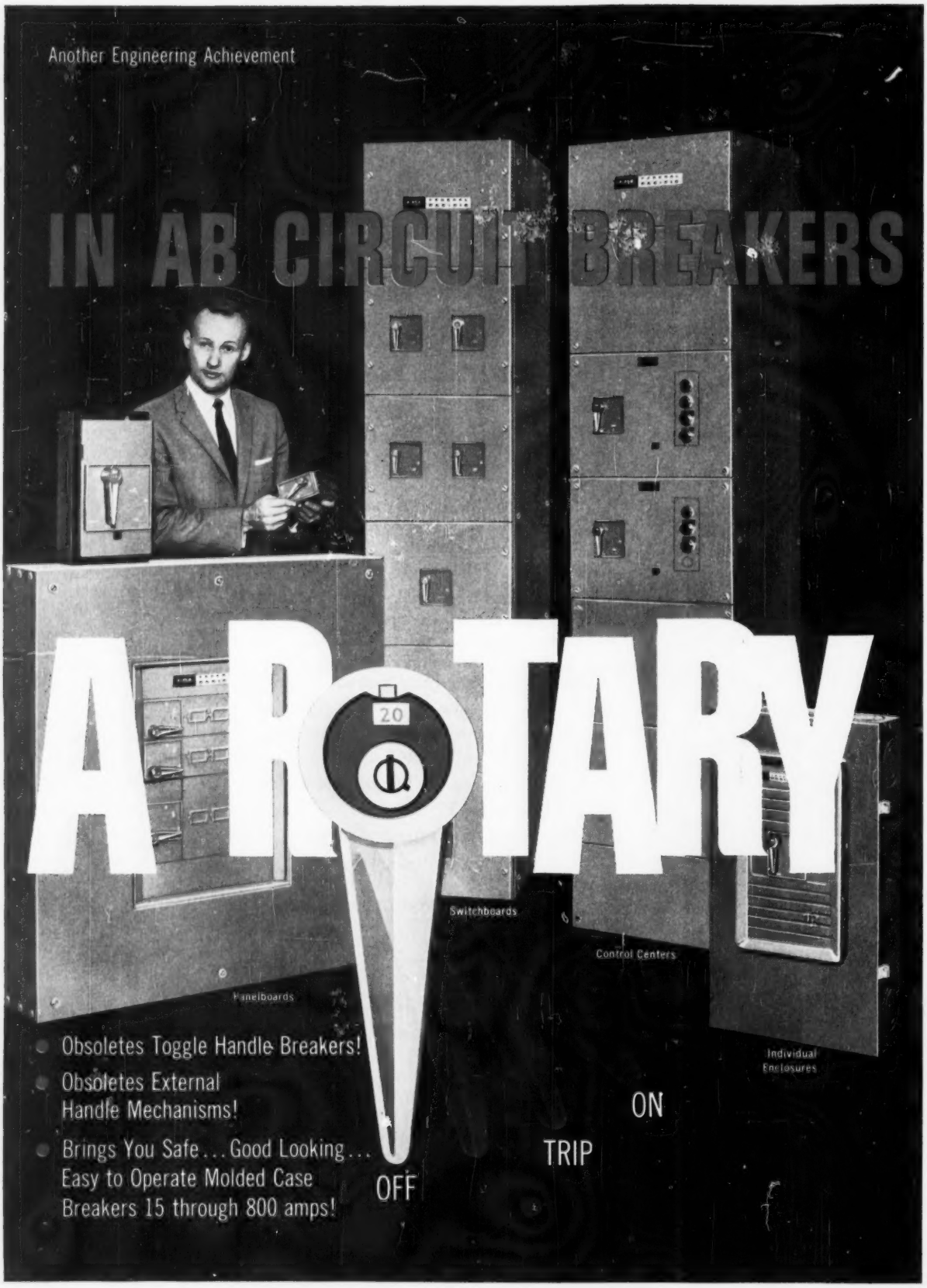
Transformer Cabinet

Telephone Cabinet

You can rely on BOSS for custom fabrication of your "specials" of any type

THE HUENEFELD CO. Engineered Products Division

2701 SPRING GROVE AVE. CINCINNATI 25, OHIO


Another Engineering Achievement
IN AB CIRCUIT BREAKERS
A ROTARY
20
Switchboards
Control Centers
Panelboards
Individual Enclosures
Obsoletes Toggle Handle Breakers!
Obsoletes External Handle Mechanisms!
Brings You Safe... Good Looking... Easy to Operate Molded Case Breakers 15 through 800 amps!
OFF
TRIP
ON

FIRST REAL CHANGE IN AB BREAKERS SINCE 1927*

NEW Ease of Operation — Smooth, easier throw... no more cumbersome handle extension.

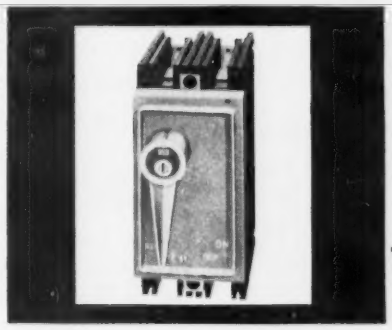
NEW Safety—Rotary handle mechanism is a built-in part of the breaker. Assures positive indication... positive operation.

NEW Economy— Eliminates excess linkage. Means simpler installation, reduced maintenance... as well as greater safety.

NEW Locking Feature — Key-handle lock off is standard...accommodates three padlocks as well.

REVOLUTION

Plus a NEW Look—Breaker face styled by Raymond Loewy Associates for best appearance in any location.



Write today for illustrated Bulletin #1425, Federal Pacific Electric Company, General Offices: Dept. 403, Newark 1, New Jersey.

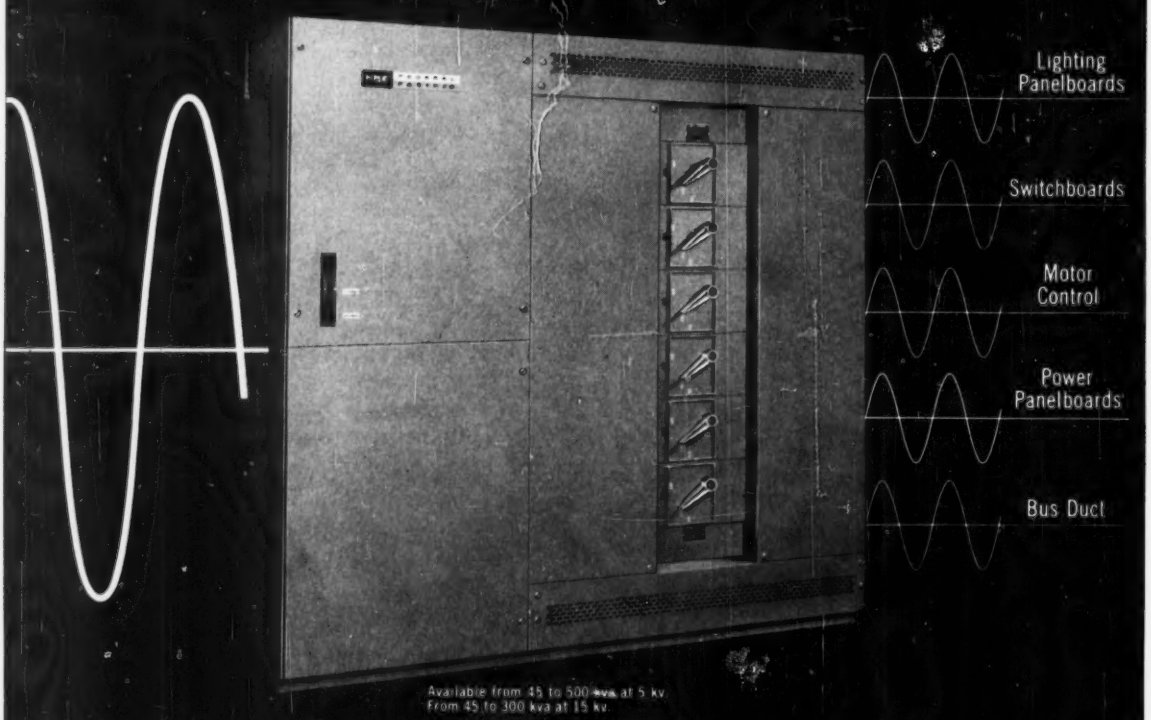
*In 1927 the first practical molded case circuit breaker was introduced. It established the general standard that was to govern circuit breaker design for the next 32 years. Now—through imaginative engineering, Federal Pacific establishes a new standard.

FPE **FEDERAL PACIFIC ELECTRIC COMPANY**

The Best in Electrical Distribution and Control Equipment

Another Engineering Achievement

FEDERAL PACIFIC
PACKAGE POWER CENTERS



give you Power on demand—Where and When you Need it

These compact, factory assembled power centers let you take advantage of economical primary power rates, lower installation costs, and reduced voltage drop on your distribution system.

UNIT RESPONSIBILITY WITH THE COMPLETE LINE OF FEDERAL PACIFIC COMPONENTS:

PRIMARY SECTION—Type IS Load Break Air Interrupter Switches.

TRANSFORMER SECTION—Dry Type Transformer—Class B Insulation—especially designed and mounted for whisper-quiet operation.

DISTRIBUTION SECTION—Rotary Handle Circuit Breakers through 800 a.—QMQB Fusible Switches through 1200 a....meet your distribution requirements.

Plus all these features:

COMPACT SIZE Up to 50% more kva per square foot of floor space. Typical 500 kva unit is only 78″ high, 77″ long, 42″ deep.

FASTER INSTALLATION Only one pre-engineered, factory-assembled unit to handle.

SIMPLIFIED MAINTENANCE All operating parts accessible from the front.

DESIGNED FOR SAFETY All high voltage parts including rotary tap changers are mounted in an interlocked compartment.

Write for Bulletin 2300, Federal Pacific Electric Company, General Offices: Dept. 404, Newark 1, New Jersey— The Best in Electrical Control, Distribution and Power Equipment.

FPE **FEDERAL PACIFIC ELECTRIC COMPANY**
Affiliated with Cornell-Dubilier Electric Corporation

Simplify interlocked armored cable installations

WITH NEW T&B FITTINGS

Each size of the new T&B Interlocked Armored Cable Fittings accommodates twice the previous range of cable sizes. They eliminate the problem of armored cable OD that is too large or too small for the fitting. The extra armor stop in T&B Interlocked Cable Fittings and the independently-bolted twin saddles make it possible to accommodate a wide range in armor diameters. The saddles are serrated for positive grip.

For dry or wet locations – T&B Armored Cable Fittings are available for both terminating in boxes or dead-ending, in both dry and damp locations. (Damp location fittings have a neoprene bushing, retainer ring and gland nut to keep out moisture.)

Other advantages: **1)** Fewer connectors are required to accommodate the full range cable sizes. Fewer items in stock. **2)** There is only one connector for each hub thread size. **3)** The basic connector and its accessories are engineered to achieve LOWEST INSTALLED COST.

All T&B products available only through authorized T&B distributors

THE THOMAS & BETTS CO.

34 Butler Street, Elizabeth 1, New Jersey
Thomas & Betts, Ltd.,
Montreal, P.Q., Canada

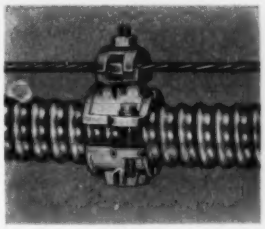
ENGINEERED

MANUFACTURERS OF FINE ELECTRICAL FITTINGS SINCE 1898

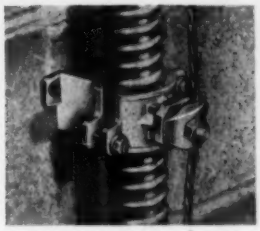
THE BASIC FITTING . . .
and T&B accessories readily solve specific installation problems . . .

FOR WET LOCATIONS

FOR GROUNDING



FOR HORIZONTAL SUPPORTING



FOR VERTICAL SUPPORTING

For complete details, with case histories on how these new T&B fittings have solved the problems of others, we will be pleased to have you participate in our informative "Eyeopener" mailing program. Simply fill out and return the coupon below.

The Thomas & Betts Co., Inc., 34 Butler St., Elizabeth 1, N. J.

Please include my name for your "Eyeopener" series about T&B Interlocked Armored Cable Fittings.

My name _____

Title _____

Company name _____

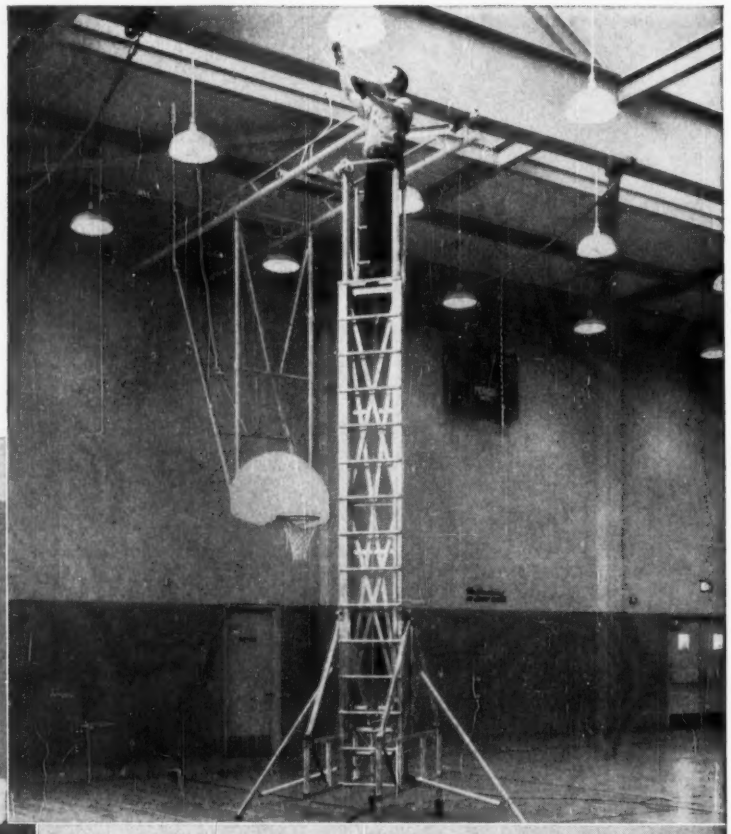
Street _____

City & State _____

UP-RIGHT ANNOUNCES

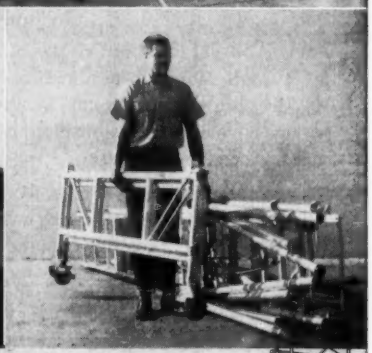
TALLESCOPE ...telescoping aluminum work platform for overhead construction and spot maintenance

Lightweight, rapidly assembled by one man. Extends instantly for reaching heights up to 30 ft. Telescopes for rolling under trusses and other obstacles. Adjustable legs for uneven floors or stairways.



Rolls through doorways . . . only 29" wide, telescopes and folds down.

Bridges over auditorium seats.



Separates easily into 3 components for convenient storage or transportation.

FOR TALLESCOPE CIRCULAR
WRITE TO
UP-RIGHT SCAFFOLDS
DEPT. 177 • 1013 PARDEE ST., BERKELEY, CALIF.

MANUFACTURED BY
UP-RIGHT SCAFFOLDS

DO IT FASTER · DO IT BETTER

with

STEELDUCT E.M.T.

and a

STEELDUCT-BENFIELD BENDER

When you follow the BLUE LINE you keep bends in alignment, eliminate crooked offsets and saddles.

SAVES TIME

SAVES MATERIAL

There's a built in "bench mark" on each length of STEELDUCT E.M.T. (½" to 1¼" inclusive)...a straight blue line from end to end that simplifies bend alignments. To take full advantage of the Blue Bendaliner Stripe, use Steelduct Benders with 90° centerlines and shrink-back marks cast in.

Write STEELDUCT for your free copy of Booklet "Making Conduit Bends That Fit."

The Blue Line is the Mark of Quality

Steelduct Products are UL approved and meet Federal Specifications WW-C-571a, WW-C-581c, WW-T-806b.

THE STEELDUCT COMPANY

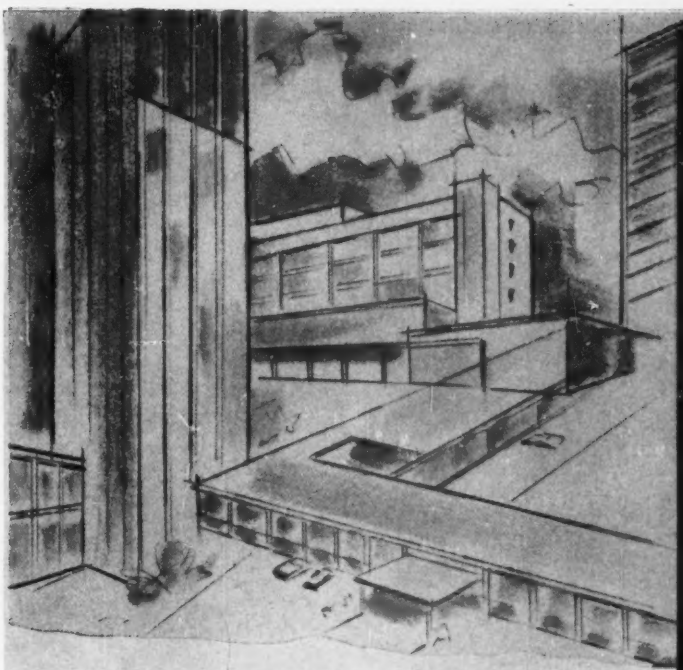
REPUBLIC STEEL BUILDING YOUNGSTOWN 1, OHIO

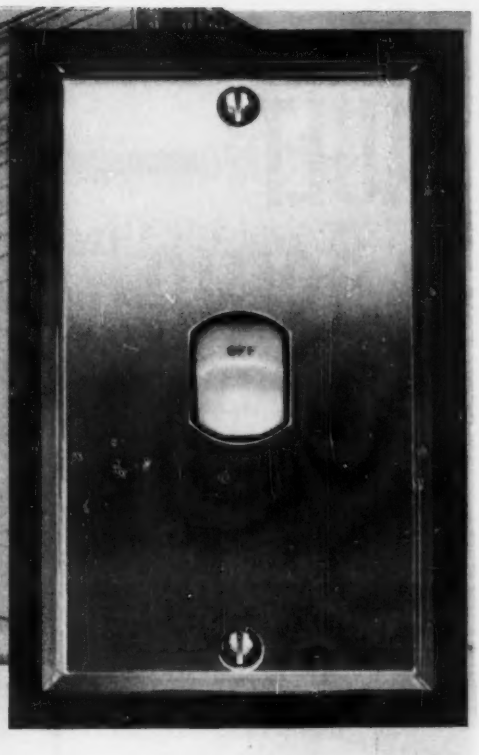
THIS IS THE FAIRVIEW

New 8-foot lighting value by Day-Brite.
With one-piece, metal-framed enclosure of X-5 plastic.
Exclusive CLEARTEX® panel for low brightness.
Upswept sides for soft gradation of light on ceiling.
Separable hinges for one-man servicing.
Clean, crisp design complements any interior.

FAIRVIEW offers all the visual comfort, quality features, and ease of installation and maintenance you expect from Day-Brite . . . at about half the price you'd expect to pay!

Applications include schools, offices and stores. Surface or suspension mounting. Available for 8-foot Slimline or 4-foot Rapid-Start lamps. For more information on FAIRVIEW, call your Day-Brite representative listed in the Yellow Pages. Or write Day-Brite in St. Louis. Day-Brite Lighting, Inc., 6260 N. Broadway, St. Louis 15, Mo.; 530 Martin Ave., Santa Clara, Calif.





THE SWITCH OF THE FUTURE

is being used NOW! . . .

P&S ROCKER-GLO SWITCH

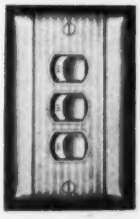
Many of today's switches are specialties primarily designed for appeal in decoration. Others are designed to meet the rugged use and performance called for by a heavy duty switch.

Now, one new switch, Rocker-Glo, combines eye-appealing design with heavy duty performance. So impressed with this combination are architects, engineers and contractors that Rocker-Glo is already being specified in leading hotels, motels, hospitals, commercial buildings and housing developments. Rocker-Glo has high-grade silver alloy contacts and positive make-and-break rocker arm construction. Its modern design and unique construction allow this switch to be pressed, pushed, rocked or rolled into instantaneous action.

Rocker-Glo switches are specification grade AC switches designed to be used at full current rating on tungsten filament and fluorescent loads (one switch takes the place of two ordinary AC-DC switches on fluorescent loads). It can be used anywhere old style toggle switches are used.

And Rocker-Glo's clean functional lines and soft beauty lend the final decorative touch.

Available in Despard interchangeable type, Despard type mounted on a strap and narrow rocker for tumbler switch plates. A specification grade switch, 15 and 20 amps. 120/277 volts AC.



Write for free Rocker-Glo bulletin – Dept. ECM-160

P&S®

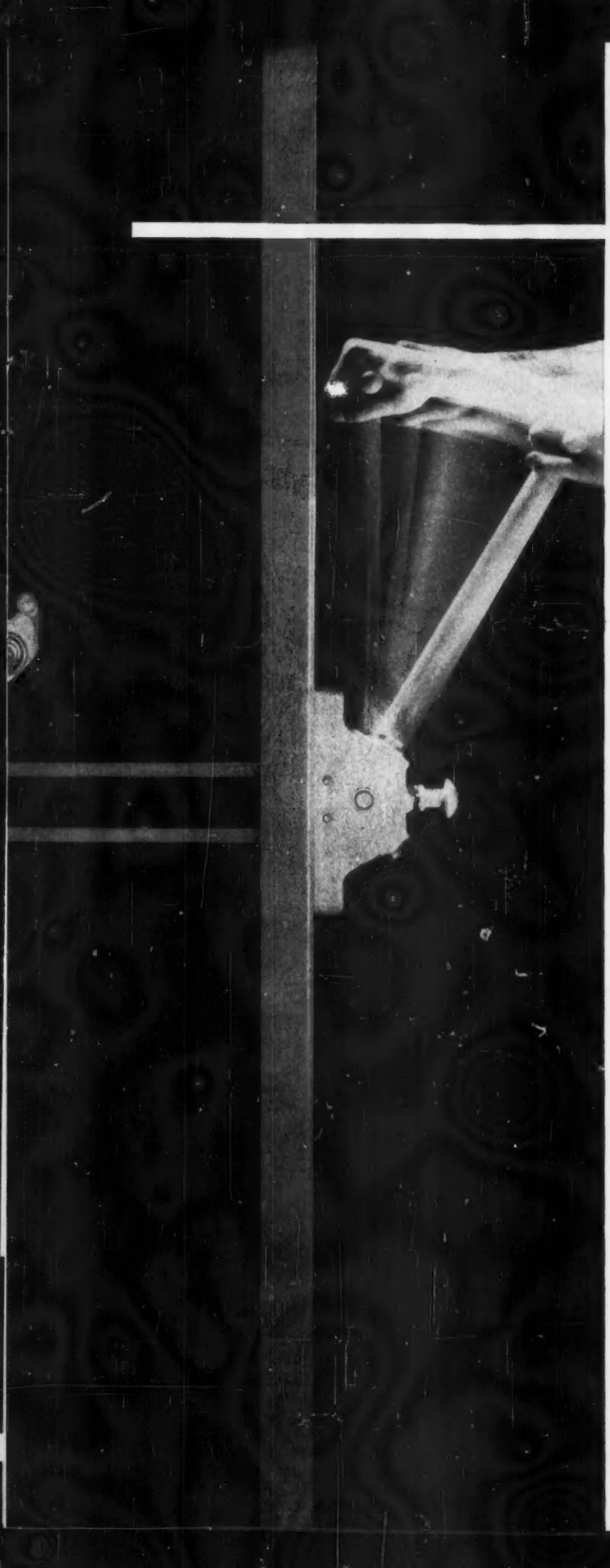
PASS & SEYMOUR, INC.

SYRACUSE 9, NEW YORK

60 E. 42nd St., New York 17, N. Y. • 1440 N. Pulaski Rd., Chicago 51, Ill. • In Canada; Renfrew Electric Co., Ltd., Toronto, Ont.

FAULT CLOSING

S&C metalclad switchgear meets all requirements of new National Electric Code for fault closing, short-circuit interruption. Performance proved by high power testing at KEMA laboratories.



S&C metalclad switchgear can close on any fault up to 60,000 amps

No danger to equipment—no danger to operator even if he closes load interrupter switch on the heaviest faults. S&C's new line of metalclad switchgear is rated as high as 44,500 amps fault closing, 500 mva short-circuit interrupting at 14.4 kv. And at 4.16 kv, the corresponding ratings are 60,000 amps, 250 mva!

Here's how it works: 1) Fault never flows through interrupting unit when switch is closed . . . it flows through separate arcing contacts; 2) Arcing is minimized and magnetic forces are overcome by quick-make, quick-break toggle action no matter how slowly operator closes handle.

Short-circuit interrupting duty (up to 500 mva) is handled by a new boric acid power fuse, the Type SM, which features multiple bore construction to handle low, medium, and high faults.

The simplicity of the S&C design—power fuses for short-circuit interruption and load interrupters for manual or automatic load switching—enables you to save as much as 50 percent on your switchgear investment. Why not consider S&C Metalclad Switchgear for your high voltage power systems? In industrial plants and commercial and institutional buildings there are rarely any transient faults, so there is no real need for the automatic reclosing ability of the more expensive circuit breaker type of switchgear.

For more information please consult the telephone directory for your nearest S&C sales office.

S & C ELECTRIC COMPANY

4433 Ravenswood Avenue • Chicago 40, Illinois

Specialists in High Voltage Circuit Interruption since 1910

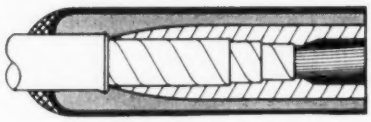
S&C

THE RIGHT CABLE JOINT FOR YOU

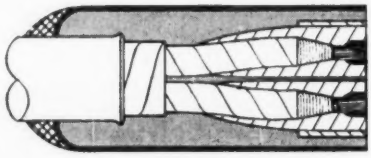
PRE-ENGINEERED

FOR LOW COST AND HIGH QUALITY

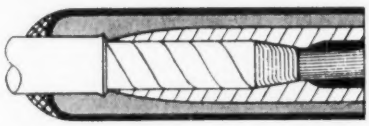
The joint design you need is most likely among the thousands of up-to-date pre-engineered designs in G&W files. They represent a thorough knowledge of the requirements of allied equipment used in power distribution.

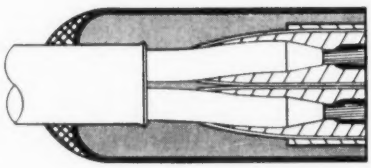


The result at G&W is a keen appreciation for the need of designing cable joints and supplying materials that are best suited to a particular type of cable.

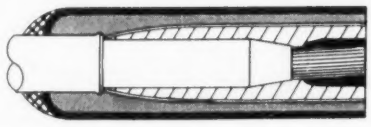


We can select the design you need in minutes. You save expensive time for engineering and ordering. G&W pre-engineering is complete to the last detail. Specifications, drawings and instructions cover the materials and the proper procedure for preparing a joint. They include each step from removing the sheath to making the splice and applying, when necessary, the protective cover or casing. This data is enclosed in the convenient unit package of materials you receive to make each joint.





Only the best quality materials are supplied by G&W. Overages are estimated to make reasonable allowances for variations of individual handling by splicers.



Do the job right the first time. Order G&W pre-engineered cable joints. Call a G&W representative for full details or write us for Bulletin JA56.

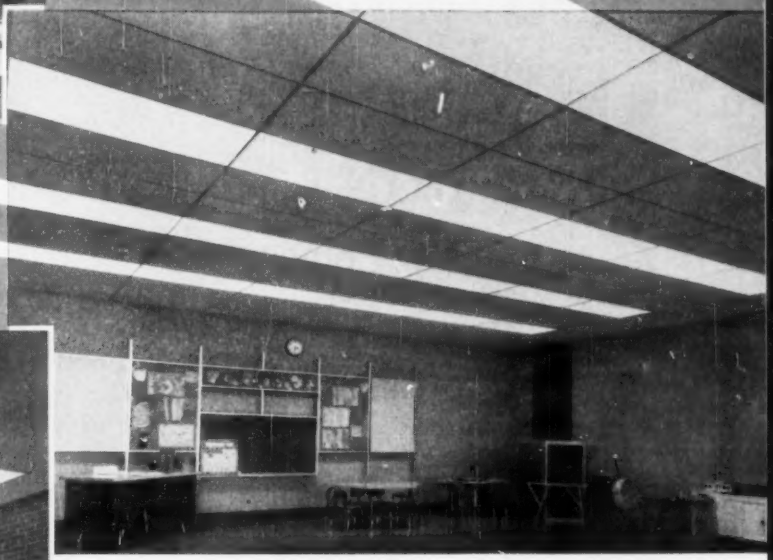
G&W ELECTRIC SPECIALTY COMPANY
3500 WEST 127TH STREET • BLUE ISLAND, ILLINOIS
CANADIAN MFR. • POWERLITE DEVICES, LTD. • TORONTO, MONTREAL & VANCOUVER

J581

middlefork school, northfield, illinois feature american plastic louvers...

for better light shielding and seeing comfort

they provide the finest in luminous shielding qualities of soft glare free illumination, with minimum of maintenance . . .



ARCHITECT: Albert R. Martin, Wilmette, Illinois
CONTRACTOR: Oman & Giden, Northfield, Illinois
ELECTRICAL: Erland's Elec. Contractors, Skokie, Illinois

Now! AMERICAN LOUVER offers 3 shielding medias—42°—45° and the all new 55° louver, for higher lighting efficiency and uncluttered appearance—they will meet your most rigid lighting requirements for individual fixtures, modules or complete louvered ceilings.

Available in 5 permanent beautiful pastel colors....

American Plastic Louvers are available in pastel colors, molded-in for permanent beauty. They provide the architect and designer unlimited possibilities with the use of colors in combinations of White . . . Blue . . . Green . . . Pink . . . Yellow and Low Brightness Grey.

Engineers are available in your area to help with your lighting problems or write American Louver Company direct.

It pays to specify American louvers

- **PERMANENT COLOR STABILITY**
- **HIGH IMPACT FOR GREATER STRENGTH**
- **EASY TO HANDLE—LIGHT WEIGHT**
- **PATENTED INTERLOCKING LOUVERS**
- **ASSURE PERFECT ALIGNMENT**
- **LOW COST UPKEEP—EASY TO CLEAN**
- **AVAILABLE IN COMBINATION OF SIZES**
- **LOUVERS MAY BE CUT TO SPECIFICATIONS**

Exclusive Process by AMERICAN LOUVER COMPANY

U. S. A. Patent No. 2,566,817 — Canadian No. 484,346

U. S. A. Patent No. 2,607,455 — Canadian No. 497,047

american louver company

4240 N. SAYRE AVENUE • CHICAGO 34, ILLINOIS

Persons in the know
are specifying fuses

HATFIELD Electric Co.,

a leading electrical contractor,
installs–

FUSETRON dual-element Fuses

in its new office building

Mr. Brown, Vice-President tells why . . .

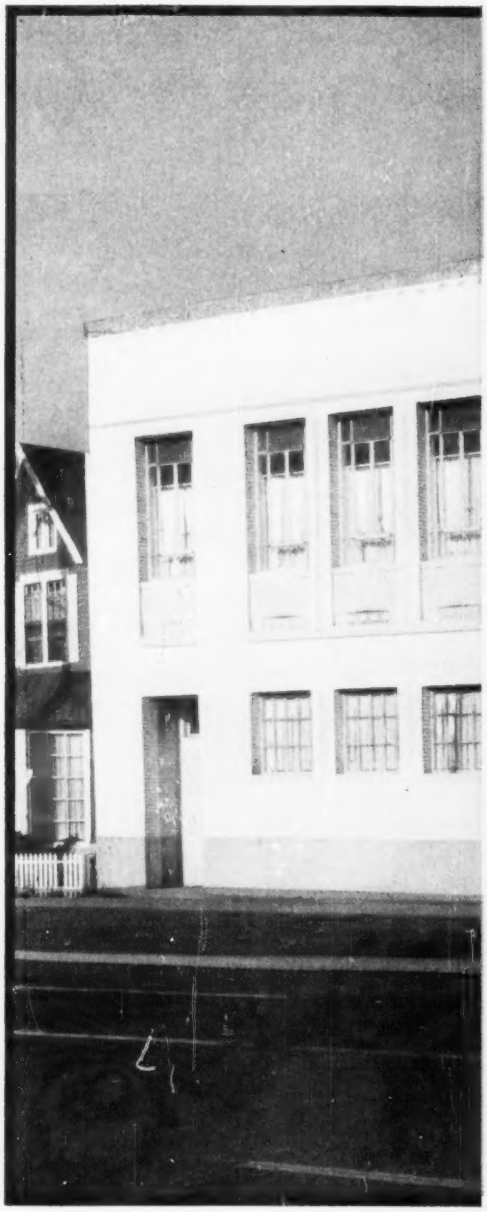
"For our own buildings and our recommendations to our industrial and commercial customers, we feel that FUSETRON fuses are the most reliable means of over-current protection that has been made available to us.

"We require protective devices for industrial and commercial application that not only provide adequate short-circuit protection but also protect against needless blows. In dead-front panel equipment it is especially desirable that they operate cool and efficiently. Of course FUSETRON fuses provide this.

"The additional protection features of these devices are of continual interest to our customers, and we feel their use is to our mutual benefit.

"As a matter of further interest, we are remotely mounting the fluorescent ballasts throughout our own offices and adding your fuse blocks with indicating FUSETRON fuses for better protection and lower maintenance."

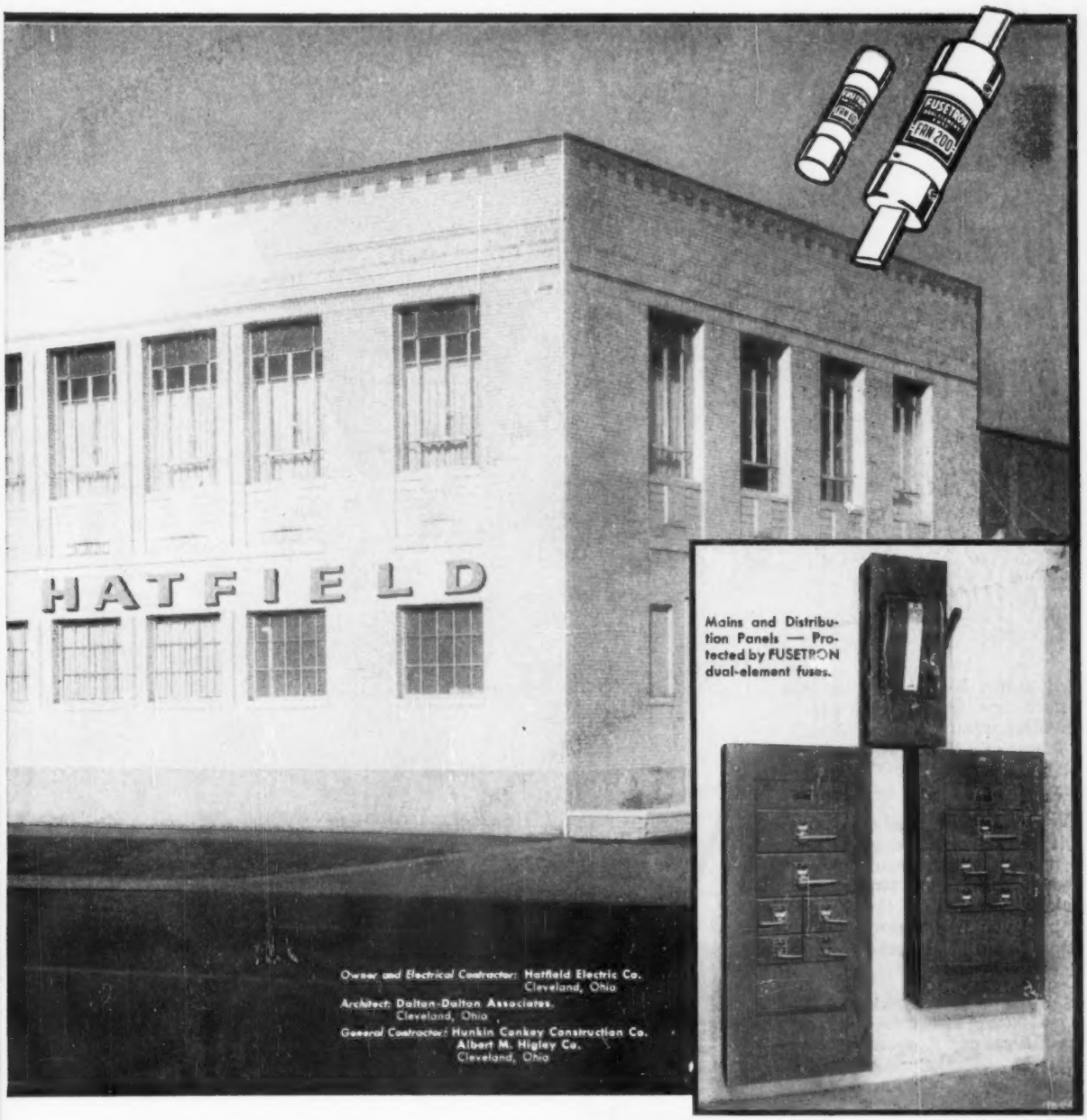
William L. Brown,
V. P. HATFIELD ELECTRIC CO.
CLEVELAND, OHIO



This Hatfield Electric Co. installation underscores the need for . . .

LIFE-TIME DEPENDABILITY AND HIGH INTERRUPTING CAPACITY IN A MODERN PROTECTIVE DEVICE — *You Get Both With* FUSETRON Fuses . . .

THERE IS A BUSS OR FUSETRON FUSE FOR EVERY ELECTRICAL NEED



Mains and Distribution Panels — Protected by FUSETRON dual-element fuses.

Owner and Electrical Contractor: Hatfield Electric Co.
Cleveland, Ohio
Architect: Dalton-Dalton Associates.
Cleveland, Ohio
General Contractor: Hunkin Conkey Construction Co.
Albert M. Higley Co.
Cleveland, Ohio

SAFE PROTECTION THROUGH THE YEARS . . .
without maintenance or recalibration costs.

FUSETRON fuses remain safe and accurate because, unlike mechanically operated devices, they have no hinges, pivots, latches or contacts to stick or get out of order.

FUSETRON fuses are *calibrated at the factory by engineers.* Once properly installed, they require no maintenance — no periodic inspection and accompanying down-time.

PROTECT AGAINST HIGH FAULT CURRENTS

A modern protective device must provide protection against today's heavy fault currents — and be able to protect against even greater fault currents that might develop in the future.

You get this protection with FUSETRON fuses. FUSETRON dual-element fuses have an interrupting rating of 100,000 amperes rms symmetrical.

Electrical Protection goes MODERN with FUSETRON fuses because they are adequate for today's conditions and for anticipated growth in service demands.

For More Information on FUSETRON dual-element fuses . . . *Write for bulletin FIS*

BUSSMANN MFG. DIVISION, *McGraw-Edison Co., St. Louis 7, Mo.*

FIVE NEW GEDNEY PRODUCTS . . .

"that fit always!"

Nobody knows better than you do how much time, trouble and expense are involved when electrical fittings don't fit properly. That's why Gedney has adopted the simplest of mottoes: *Gedney Fittings fit.* And we mean it!

Gedney Fittings are machined with unfailing accuracy, then carefully finished, finally they're scrupulously inspected. *Result?* You no longer have to make allowances for the fittings (and time) you used to throw away! One more thing. These better fittings cost you no more!

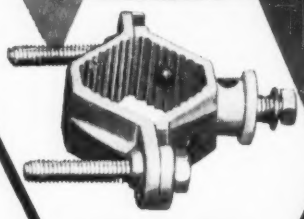
Think of all the places you can save time and money with these five new Gedney Fittings and Accessories!

GEDNEY INSULATED MALLEABLE IRON BUSHINGS
(cadmium-plated). Polyethylene collar is free to turn while bushing is tightened...prevents binding, twisting, during installation. Sizes ½" to 6".

GEDNEY JUMPER WIRE BONDING BUSHING.
Solderless lug. Malleable iron, cadmium-plated, available sizes ½" to 4".

GEDNEY INSULATED MALLEABLE IRON GROUND BUSHINGS
(cadmium-plated). Solderless lug. Free-turning polyethlyene collar prevents binding, twisting, of conductors. Sizes ½" to 4".

GEDNEY PUSH-PULL TAB CAP.
For plugging bushings, etc. Use again and again. Strong polyethylene, in sizes ½" to 2".



GEDNEY STATIC PREVENTIVE GROUND CLAMPS.
Made to ground pipe or conduit from ½" to 8".

GEDNEY FITTINGS FIT

GEDNEY
ELECTRIC COMPANY

RKO BLDG. • RADIO CITY • NEW YORK 20
Foundry, Factory and Shipping Point: Terryville, Conn.

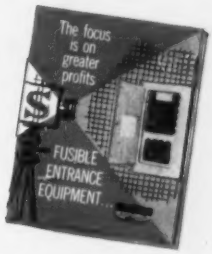
Cut installation time 26% with Cutler-Hammer **FACTORY-FINISHED** *Fusible Service Entrance Equipment*

Experienced electrical contractors know "time" is a mighty important factor on every job, large or small. This is why most prefer to install 100% *factory-finished* Cutler-Hammer Fusible Service Entrance Equipment to avoid the time-wasting, profit-wasting task of job-site equipment assembly.

In recent tests, electrical contractors were clocked while they installed both the "do-it-yourself" types and complete Cutler-Hammer panels. The results show Cutler-Hammer's *factory-finished* equipment can be installed in 26% less time. Yes, jobs go faster with Cutler-Hammer Fusible Service Entrance Equipment . . . 26% faster. And the time saved means more profit per job, more jobs per week.

Start using Cutler-Hammer Fusible Service Entrance Equipment today . . . 100% *factory-finished* at no extra cost. Your nearby Authorized Cutler-Hammer Distributor carries a complete line of panels ready for immediate delivery.

Write today for the new illustrated selection guide. Ask for Publication ED50-A241. Cutler-Hammer Inc., Milwaukee 1, Wisconsin.



CUTLER-HAMMER CONTROL C-H

CUTLER-HAMMER

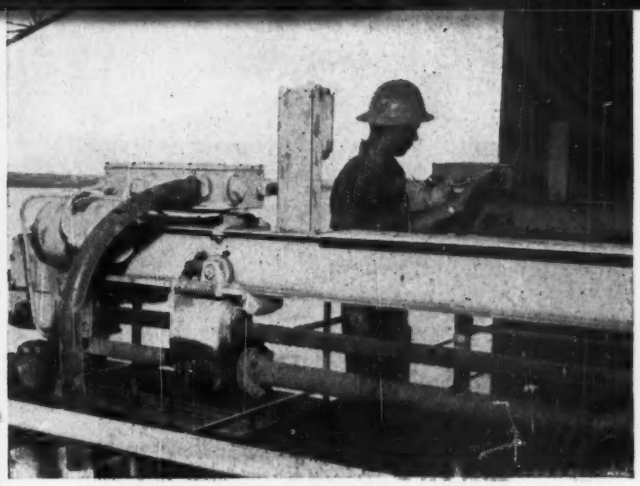
Cutler-Hammer Inc., Milwaukee, Wis. • *Division:* **Airborne Instruments Laboratory.** • *Subsidiary:* **Cutler-Hammer International, C. A.**

Associates: Canadian Cutler-Hammer, Ltd.; Cutler-Hammer Mexicana, S. A.; Intercontinental Electronics Corporation.

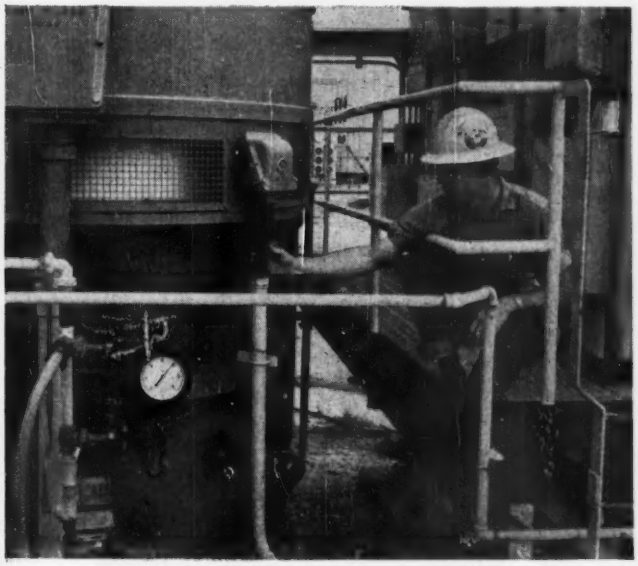
SULFURIC ACID, FUMES AND WATER would knock out these pump motor leads in short order if they weren't protected in ¾" Sealtite.

HEAT AND DUST can't hurt the control wiring leading to this bank of soot blowers because it's protected in 3" Sealtite.

CHEMICAL FUMES AND WATER are the main reasons why these sulfite pump motors are encased in ¾" Sealtite.

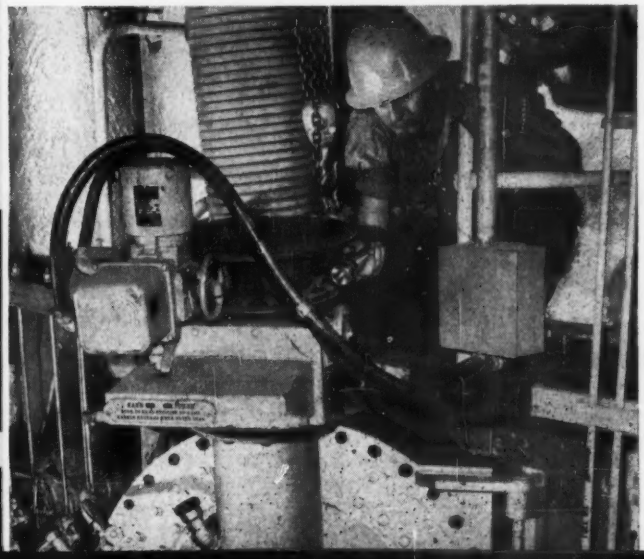


HEAT, STEAM, VIBRATION AND WEATHER would ruin wiring to these soot blowers if not protected in 2" Sealtite.



SALT SPRAY AND WEATHER buffet these circulating water pump motor connections all year round. But 3½" and 1¼" Sealtite keep wiring dry and trouble-free.

HEAT, COAL DUST AND VIBRATION would constantly threaten this control wiring connecting coal gates and motor leads if it weren't protected in 1" and ¾" Sealtite.



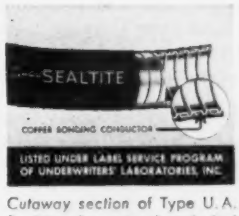
EVEN SULFURIC ACID CAN'T HURT WIRING PROTECTED WITH SEALTITE FLEXIBLE, LIQUID-TIGHT CONDUIT

Sulfuric acid, caustic soda, hot soot, grime, steam, salt spray, weather and vibration are eight good reasons why Tampa Electric sealed 600 feet of crucial wiring in Sealtite at their recently expanded Gannon Power Station.

Even these roughest of service conditions can't faze this flexible, liquid-tight conduit. Its tough extruded polyvinyl jacket proves itself in arctic cold and tropical heat. It resists moisture, oil, dirt,—even salt spray and corrosive chemical fumes. And—its flexible metal interior absorbs vibration. That's why Sealtite often outlasts rigid conduit.

Look over the examples to see how Tampa Electric takes full advantage of Sealtite. One of them might suggest a way you, too, can increase your wiring efficiency by eliminating potential trouble spots.

WHERE TO GET SEALTITE—Electrical Wholesalers stock Types U. A. and E. F. Sealtite in easy-to-handle coils, in black or gray. Be certain you ask for and get the quality conduit marked "Sealtite" and "Anaconda" on the cover. Buy it in long lengths on reels or in cartons and cut it on the job without waste. Your wholesaler also stocks liquid-tight connectors. Free Booklet S-542 gives full information on Sealtite. Write: Anaconda Metal Hose Division, The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. Sealtite is approved by Canadian Standards Association. 59144



Cutaway section of Type U. A. Sealtite shows tough polyvinyl chloride jacket over flexible metal core. Copper conductor wound spirally inside conduit provides positive ground.

Insist on the conduit marked

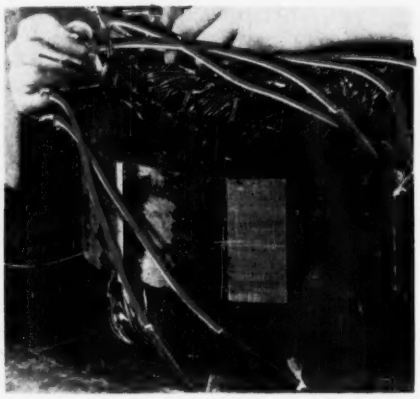
SEALTITE®

Flexible, Liquid-Tight Conduit

AN ANACONDA® PRODUCT

SILICONE NEWS from Dow Corning

Use One Wire Throughout



SILASTIC® SILICONE RUBBER gives sure protection in any installation

The beauty of this wire is that you can use it practically anywhere. Because it's insulated with Silastic, the Dow Corning silicone rubber, and Silastic is amazingly versatile. It can take heat up to 500 F. It can take outdoor weathering indefinitely. It's highly flexible, and allows wire to be soldered with ease by gun or dip method because it won't shrink or peel under heat. Should a sudden surge of power overheat the wire, Silastic will keep right on insulating. Also, Silastic resists the damaging effects of ozone often present near electrical equipment. Add all these advantages together and they spell economy, long service, freedom from maintenance. You can use wire covered with Silastic throughout a whole plant, rather than specifying a dozen different specialty wires.

Shown are a few of the areas where lead wire insulated with Silastic is currently being used: on boiler heating coils, motors, outdoor signs. Most leading manufacturers now offer power cable, control cable, hook-up wire, fixture wire, and building wire with insulation of Silastic. These latter two, of course, meet accepted UL standards.

Why not get the details on the benefits of this exceptional insulation? For a list of wire and cable suppliers and further information, write Dow Corning, Dept. 3901, or contact the Dow Corning office nearest you.

If you consider *all* the properties of a silicone rubber, you'll *specify Silastic.*

first in silicones

Dow Corning CORPORATION
MIDLAND, MICHIGAN

ATLANTA BOSTON CHICAGO CLEVELAND DALLAS LOS ANGELES NEW YORK WASHINGTON, D. C.

OVER 1000 AUTHORIZED ADVANCE SERVICE-STOCKING DISTRIBUTORS DISPLAY THIS PLAQUE

In Hickory, North Carolina, and in hundreds of other cities in the U.S.A., there is an Authorized Service-Stocking Distributor to supply ADVANCE fluorescent lamp ballasts for immediate replacement.

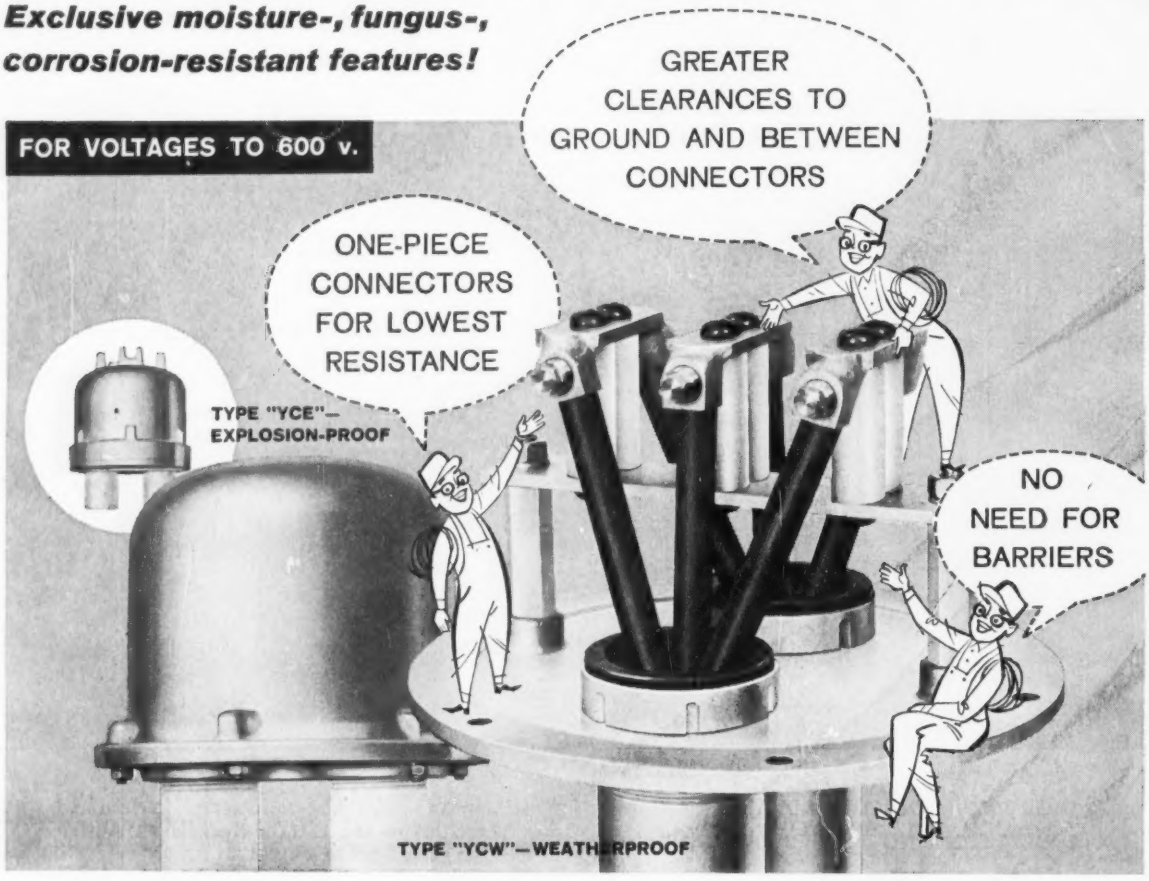
Now it is easier than ever to get immediate replacement service for any make fluorescent lamp ballast whenever replacement is necessary. Over 1000 ADVANCE Service-Stocking Distributors throughout the United States have been authorized to display the sign at the left. They carry a complete stock of all ADVANCE ballasts, individually packaged.

For immediate service take the inoperative ballast, regardless of make, to any authorized ADVANCE distributor. He will consult his ADVANCE Cross-Reference Guide for the correct replacement ballast and supply it off the shelf from his stock. Remember, look for this sign. It's your guarantee of immediate replacement service with quality ADVANCE Ballasts. Write for your copy of the ADVANCE Service-Stocking Distributor list today!

ADVANCE®
CBM CERTIFIED
World's Largest Exclusive Manufacturer of Fluorescent Lamp Ballasts
TRANSFORMER CO.
2950 NO. WESTERN AVE. CHICAGO 18, ILL. U.S.A.

NEW! O.Z. PULL-N-SPLICE BOXES!
CONVENIENT · COMPACT · ECONOMICAL

Exclusive moisture-, fungus-, corrosion-resistant features!



O.Z. Pull-n-Splice Boxes mark a significant advance in pull box construction!

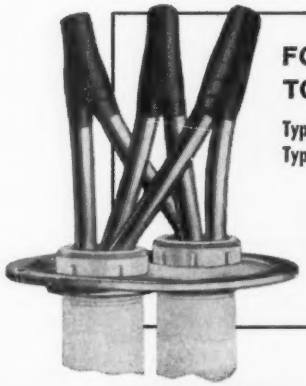
Their highly compact size saves *more space than ever!*

Their more efficient design means *new savings in installation time and labor!*

Their moisture-, fungus-, and corrosion-resistant features mean long, trouble-free service.

Still, with all their features, the new O.Z. Pull-n-Splice Boxes are *smaller* — and *cost far less* than conventional pull boxes . . . even late model *competitive* types! And, you get a bonus in high quality materials and workmanship so characteristic of *all* O.Z. products!

For complete information on these and the many other O.Z. products that mean more for you, call your local O.Z. distributor, or write to the company.



FOR VOLTAGES TO 5000 v.

Type "YPW" — Weatherproof
Type "YPE" — Explosion-proof

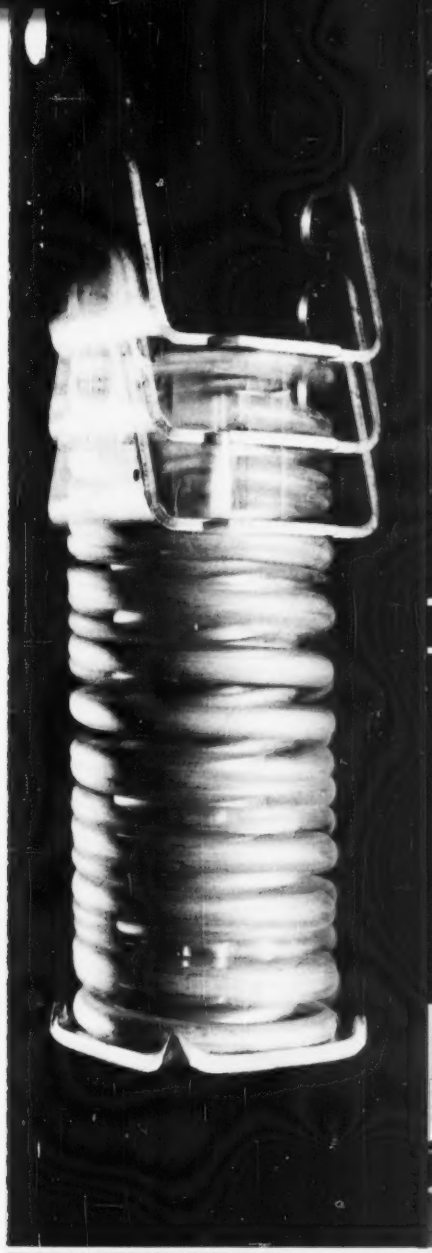
Deeper dome than "YCW" and "YCE". Furnished without connector panels. Insulated pigtail splices recommended.

O.Z. ELECTRICAL MANUFACTURING CO., INC.

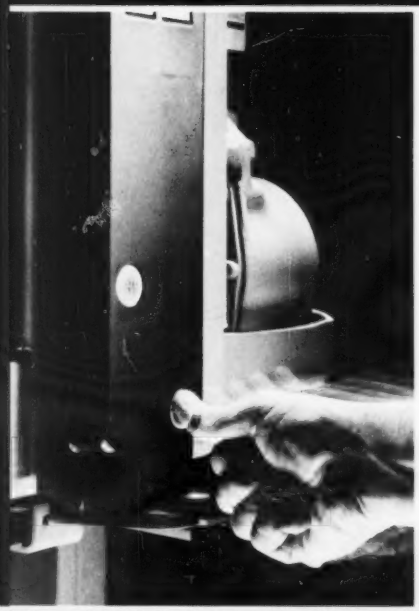
262 BOND STREET • BROOKLYN 17, N. Y.

- CAST IRON BOXES
- CABLE TERMINATORS
- POWER CONNECTORS
- SOLDERLESS CONNECTORS
- GROUNDING DEVICES
- CONDUIT FITTINGS
- INTERLOCKED ARMOR CABLE FITTINGS

Sales Office and Warehouse: 406 So. Cicero Avenue, Chicago 44, Ill. • ESterbrook 9-0326
Office and Factory: 749 Bryant Street, San Francisco 7, Calif. • GArfield 1-7846



Manually Operated or

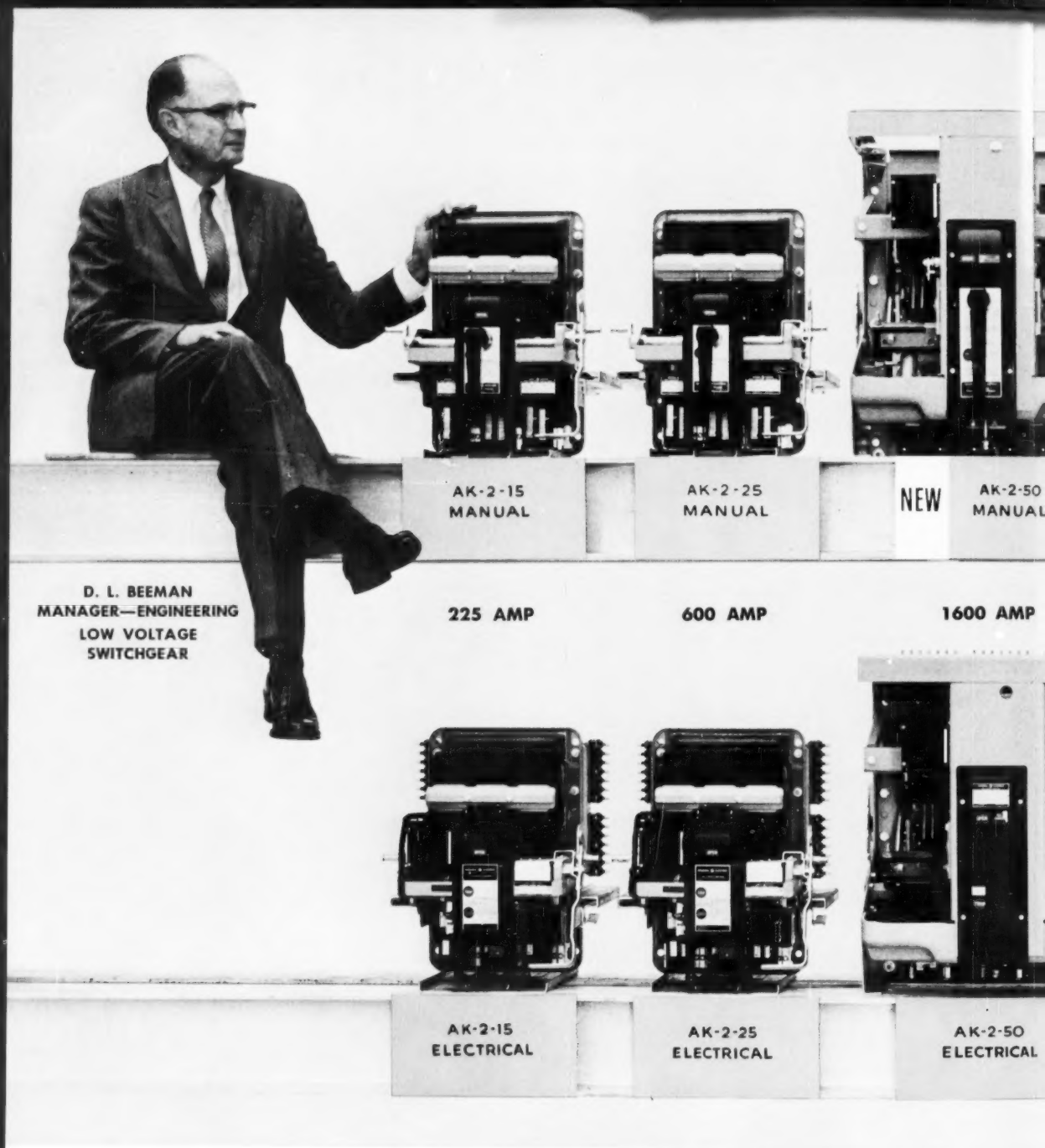


Electrically Operated

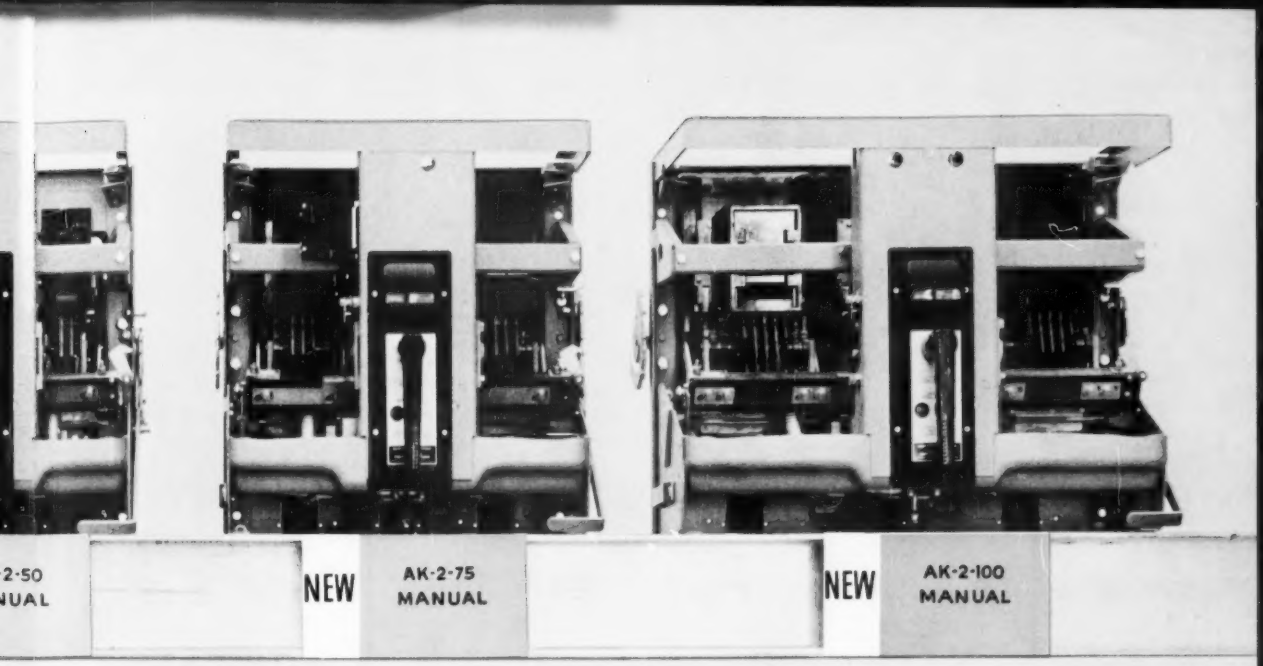
Industry's ONLY COMPLETE LINE of STORED-ENERGY low-voltage Power Circuit Breakers

SEE COMPLETE G-E LINE

GENERAL ELECTRIC

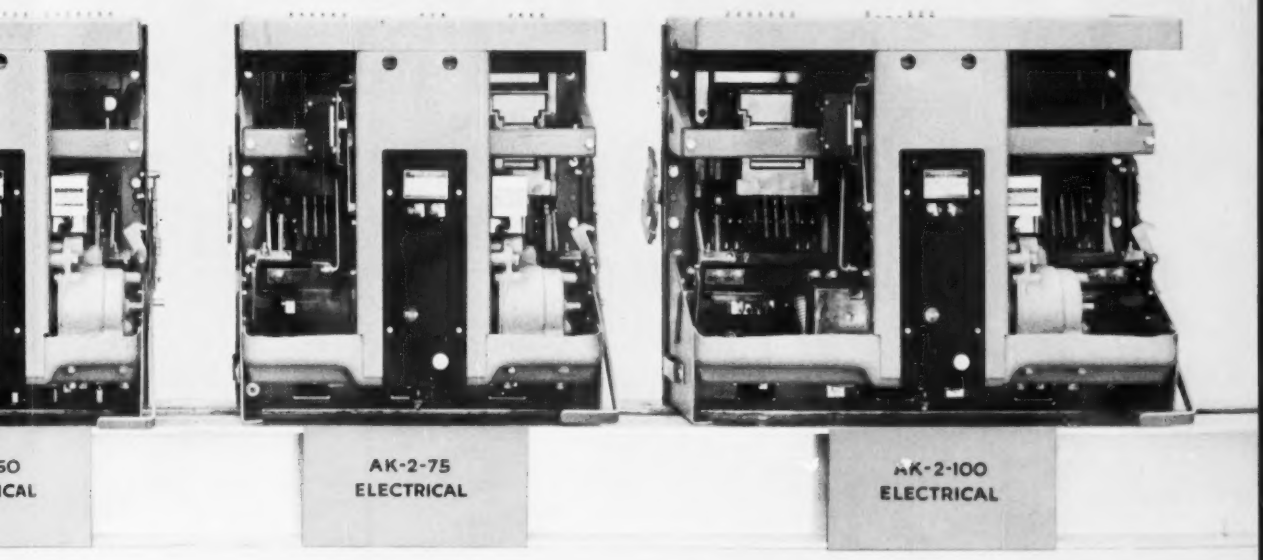


Stored Energy in All These Breakers Means Better Protection at Lower Cost



3000 AMP

4000 AMP

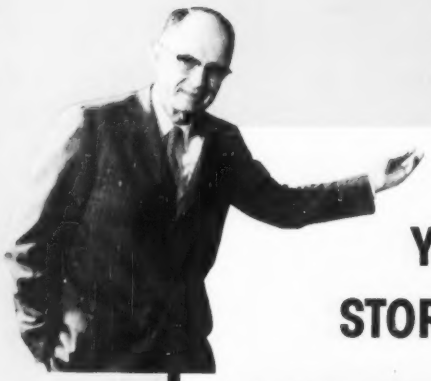


All General Electric power circuit breakers 600 volts and below now employ modern stored-energy (spring-close) mechanisms . . . which can be operated either manually or electrically.

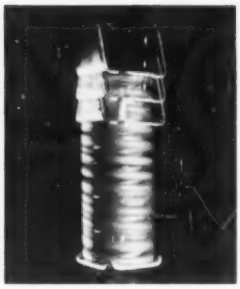
General Electric AK-2 breakers with stored-energy give better service through increased safety, longer life, easier maintenance and application versatility.

TURN THE PAGE TO FIND OUT WHAT THIS FULL LINE CAN DO FOR YOUR SYSTEM.

GENERAL ELECTRIC



You'll Be Safer With STORED ENERGY Because...



THE SPRING SUPPLIES THE EXCLUSIVE CLOSING FORCE . . .

. . . WHETHER MANUALLY OPERATED . . .

. . . OR ELECTRICALLY OPERATED

The stored-energy breaker will last longer, need less attention because it closes with constant force.

You'll Save Money With MANUALLY OPERATED STORED ENERGY

- **SAVE** up to $500 per breaker position on preferred selective tripping systems.
- **SAVE** by using breakers for intermittent motor starters, often at lower cost than conventional motor starters.
- **SAVE** by substituting for more costly electrical breakers, when remote closing is not required.

534-1

ASK YOUR GENERAL ELECTRIC SALES ENGINEER FOR MORE INFORMATION

Progress Is Our Most Important Product

GENERAL ELECTRIC

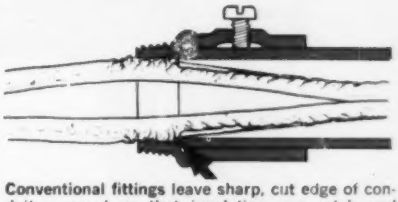
HERE IS BIG NEWS FROM Conduit Fittings

THE NEW STEEL SET SCREW CONNECTOR THAT ELIMINATES INSULATION DAMAGE DURING PULL-THROUGH

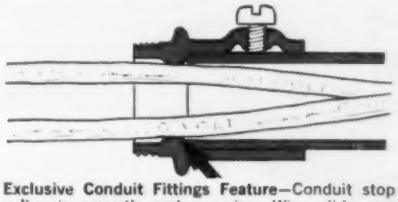
Check the features of this new line of connectors and couplings from Conduit Fittings. You'll agree this fitting gives you far more than anything in the field. Yet, it's competitively priced.

- One piece, solid tubular steel
- Embossed Surface Provides superior thread area for set screw
- Jagged burrs on edge of set screw hole are eliminated
- Pre-set screws eliminate lost time on the job
- Case hardened screw assures positive contact—greater hold power
- Chrome-Brite plating fights corrosion
- Rolled threads simplify fastening, save time
- Deep threading on neck of connector insures maximum security in box
- Heavy duty locknut
- 1¼", 1½", 2" connectors have two set screws; couplings have four set screws.

WRITE OR CALL FOR DETAILS



Conventional fittings leave sharp, cut edge of conduit exposed so that insulation can catch and strip. Pull through is difficult. Shorting possible.



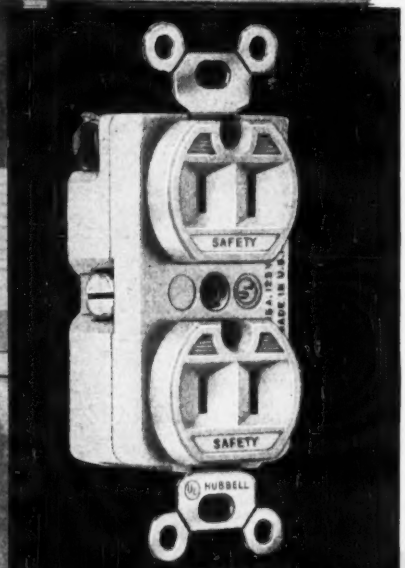
Exclusive Conduit Fittings Feature—Conduit stop collar is smooth and oversize. Wire glides on rounded edge of collar. Wire is protected, pull-through easy.

USI Conduit Fittings DIVISION OF U.S. INDUSTRIES, INC.

6400 W. 66th Street • Chicago 38, Illinois
Telephone: PO 7-8900

IT PAYS TO HAVE HUBBELL GOOD CONNECTIONS

NOW THEY'RE BOTH



SG-62-I (Safety Grounding) Duplex Receptacle 15 ampere, 125 volt

Listed by Underwriters' Laboratories, Incorporated

EXTRA SAFETY FOR

HOMES
SCHOOLS
NURSERIES
HOSPITALS
SANITARIA
PRISONS
WORKSHOPS
GARAGES

---SAFE

NEW HUBBELL TWINSAFE

SAFETY GROUNDING RECEPTACLE

- PROVIDES GROUNDING PROTECTION FOR USERS OF ELECTRICAL TOOLS AND EQUIPMENT
- SHUNTS CURRENT HARMLESSLY AWAY FROM OBJECTS INSERTED IN SLOTS BY CHILDREN

Only Hubbell "TWINSAFE" provides these 2 Safety Features

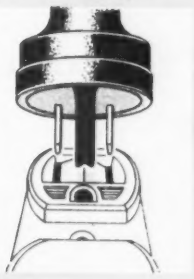


FIG. I—A slot for grounding power tools and appliances equipped with plugs having U-shaped grounding blade.

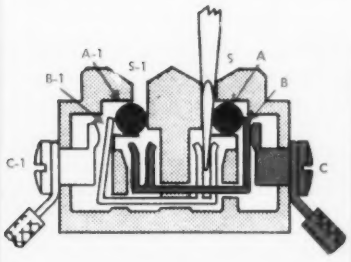


FIG. II.—Internal construction that shunts current harmlessly away from inserted metallic objects. Red indicates parts carrying current.

You will find *two* safety features in the new Hubbell "Twinsafe" receptacle that are combined in no other convenience outlet today:

A U-shaped grounding slot that instantly grounds power tools and appliances equipped with any standard grounding cap, as in Fig. 1.

A design that permits current to flow out through the slots only when both blades of a standard cap are firmly in place.

If, as shown in Fig. 2, a metal object thicker than 0.031″ is inserted in one slot, it causes fibre insulating disc A to press against spring B, causing B to touch C, which is the power supply. But instead of the power's flowing to clip B_1 which the inserted object is touching, "Twinsafe" construction shunts the power harmlessly to the opposite slot. (Note that, on the side of the idle slot, spring B_1 is not touching power supply C_1 because disc A_1 is not pressing against it.

Protection is complete even if a child tries to insert both points of a hairpin in the two slots at once. The insulating discs are so positioned as to make entry difficult. Furthermore, for the discs to be moved enough to establish the internal electrical contact, the inserted object must be more than 0.031″ thick—which the leg of a hairpin is not.

The Hubbell "Twinsafe" receptacle SG-62 for 15-ampere, 125-volt current costs only a trifle more than ordinary equipment, but it is worth many times the difference in added safety and peace of mind. In schools, mental institutions, hospitals, prisons, and similar structures, use of "Twinsafe" is practical insurance against tragic accidents.

"Twinsafe" receptacles fit standard outlet boxes and are installed by qualified electrical contractors.

For complete information see Sweet's 31 b/Hu, or write

HARVEY HUBBELL, INCORPORATED

BRIDGEPORT 2, CONNECTICUT IN CANADA, SCARBOROUGH, ONTARIO

Revere Outdoor Lighting makes driving and parking safe and easy at Eastpoint Shopping Center, Baltimore, Md. The well lighted parking lot makes the shopping center look more inviting. Architect: Kenneth C. Miller; Consulting Mechanical Electrical Engineers: Whitman, Requardt & Associates; Electrical Contractor: Harry A. Goldberg Co.; Electric Wholesaler: Graybar Electric Co., Inc.

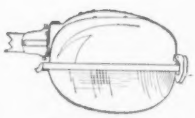
Revere's complete line of matched equipment makes any outdoor lighting job easier

Any outdoor lighting problem is easier to solve with Revere equipment. The wide line, from one source, lets you select the exact combination of fixtures required to do the job best . . . simplifies ordering and assures on-schedule delivery, too.

At Eastpoint Shopping Center (above), Revere Endoval Mercury Luminaires, mounted on Revere hinged poles, illuminate driving lanes. Parking area lighting is provided by Revere floodlights with 400-watt EH-1 mercury lamps. Floodlights are mounted two or three to a Revere hinged pole, with pole spacing 150 ft. Ballasts are in manholes between poles. Average maintained footcandles 1.1.

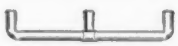
Installation of equipment at Eastpoint was easier because Revere components are *matched* for strength, balance, and perfect fit . . . and for peak lighting efficiency. Write for a Revere outdoor lighting equipment catalog. The complete, matched line makes solving any outdoor lighting problem easier.

Revere components used to light shopping center



No. 2222 Endoval Mercury Luminaires

No. 3351 Floodlights



No. 217-P Brackets

No. 800 Series (mast arm not shown) and No. 199-D-30 Hinged Poles

No. 199-J Brackets

Revere ELECTRIC MFG. CO.

OUTDOOR LIGHTING

Revere Electric Mfg. Co. • 7420 Lehigh Avenue • Chicago 48, Illinois (In suburban Niles)
Long Distance Phone: NIles 7-6060 • Chicago Phone: SPring 4-1200 • Telegrams: WUX Niles
In Canada: Curtis Lighting, Ltd., Leaside, Toronto, Ontario

INSTALLED IN

3 MINUTES

Design advantages of General Electric CR106 magnetic starters save installation time and costs

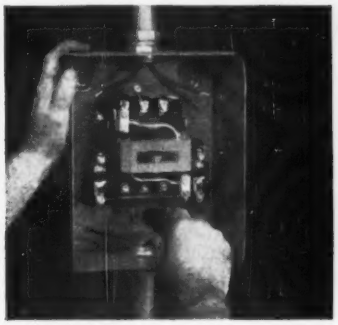
Because of such important design advantages as straight-through wiring, pressure-type terminals, three-point mounting and front accessibility, General Electric 100 Line magnetic starters (size 0, 1 and 2) can be installed in just three minutes in a mounted enclosure.

We invite you to measure these advantages by the minutes and dollars they can save in your installation work. For more information contact your apparatus distributor or write General Electric Co., Section 732-4, Schenectady, New York. Ask for bulletin GEA-7020.

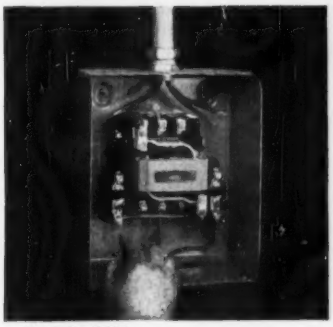
you get **MEASURABLE ADVANTAGES**
WITH GENERAL ELECTRIC CONTROL

GENERAL ELECTRIC

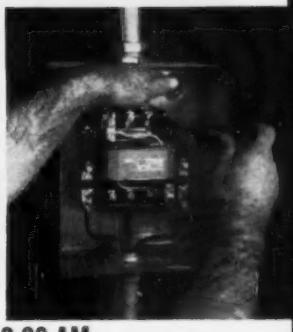
9:00 AM A size 2 starter, for example, can be mounted in enclosure quickly and easily. It is 55% lighter, 34% smaller than previous open forms.



9:01 AM Three-point mounting of starter speeds installation. Keyhole slot at top and 2 slots at bottom slide over mounting screws. Just "hang on and tighten."



9:02 AM Straight-through wiring saves time because no leads need to be bent around sides of the starter. General Electric enclosure has 10% additional wiring room.

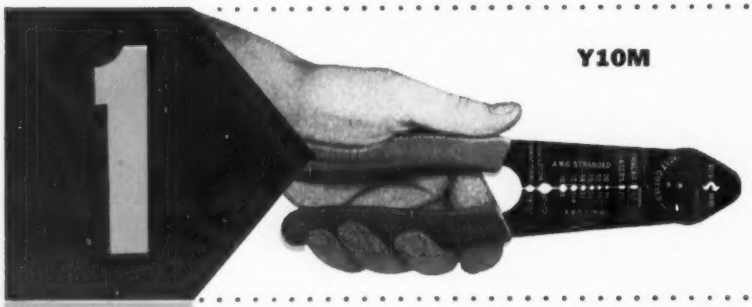


9:03 AM Pressure-type terminals are accessible from the front—easy to see and easy to reach. Just insert stripped wire in the terminals and then tighten.

GET THE BIG 3

IN COMPRESSION-CONNECTOR TOOLING

1



Y10M

Light-weight hand tool installs a wide variety of HYDENT® connectors on wire sizes #22 thru #10. A wire cutter and single indentor die for all wire sizes are in the nose of the tool. Other features are wire stripper, bolt cutter, thread chasers, and dies for closing insulation-grips.

$3.95ea

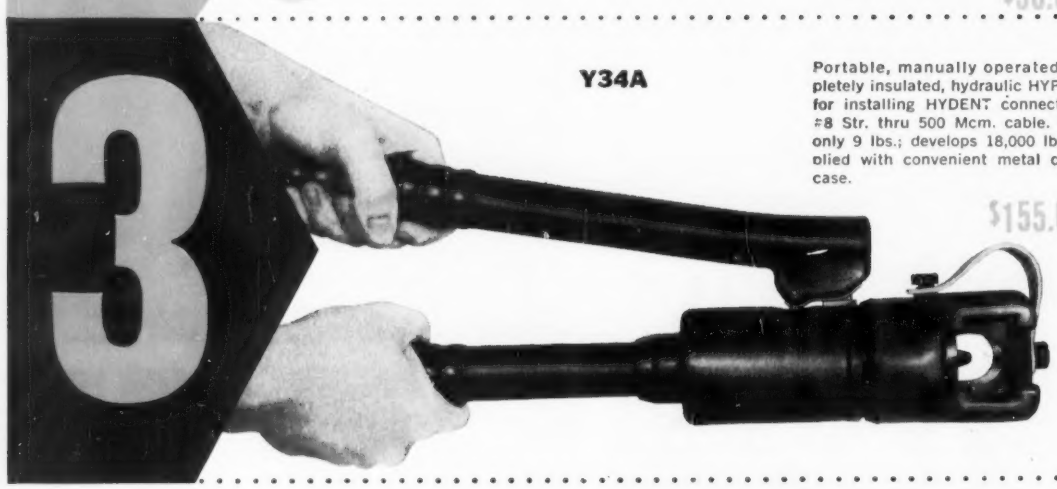
2

MY29-3

This HYTOOL® features one easily adjusted die set that installs HYDENT on commercial copper cable from #8 to 250 Mcm. and on aluminum conductors #8 to 4/0. Indexing plates are used for setting adjustable nest die for either copper or aluminum. No dies to install, change, identify or lose.

$36.00ea

3



Y34A

Portable, manually operated, completely insulated, hydraulic HYPRESS® for installing HYDENT connectors on #8 Str. thru 500 Mcm. cable. Weighs only 9 lbs.; develops 18,000 lbs. Supplied with convenient metal carrying case.

$155.00ea

Contractors with an eye on cutting connector installation time count on the Burndy Big 3. This Y10M, MY29-3, Y34A combination crimps practically every type and size compression connector on any job...adds the versatility, speed, and economy that result in profitable jobs. See your local Burndy distributor for demonstration.

BURNDY

59-15

Norwalk, Connect. In Europe: Antwerp, Belgium Toronto, Canada

All your answers are in the bag with PYRAMID

Amprobe Test-Master Kit keeps all equipment right at hand...handsomely.

Truly the sign of the professional, this rugged, good-looking, genuine cowhide case contains all the equipment *you* need to do all your electrical testing jobs with precision and accuracy.

Compact, neat and sturdy, the Test-Master Kit is specially designed to hold any one of the famous Amprobe RS models, the Amprobe Deca-Tran, the Amprobe Energizer and the Test-Master has a separate covered section to hold your small hand tools easily, within reach.

The Test-Master comes in two models: **TM33** contains the world-famous Amprobe RS-3 snap-around volt-ammeter-ohmmeter: 5 current ranges, 3 voltage ranges. Amprobe Deca-Tran: Extends amperage reading 10x, as high as 1200 amps. Amprobe Energizer: Multiplies sensitivity of any Amprobe 10x for readings on small appliance and fractional h.p. motors. **$84.50**

TM11 contains the Amprobe RS-1, economy snap-around volt-ammeter. Amprobe Deca-Tran and Amprobe Energizer. **$71.75**

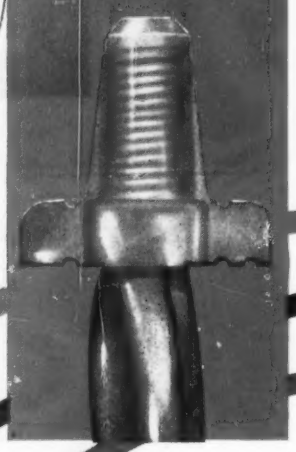
The Amprobe Test-Master Kit, RS-3, Deca-Tran and Energizer are all products of

PYRAMID INSTRUMENT CORPORATION, LYNBROOK, N.Y. WORLD'S LARGEST MANUFACTURER OF SNAP-AROUND TEST INSTRUMENTS

Just a twist of the wrist makes

IDEAL

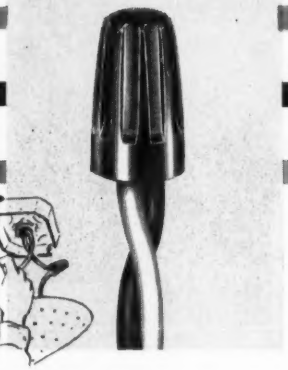
for heavy gauge branch circuits



Wing-Nut

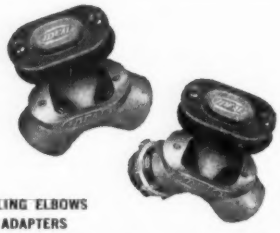
The newest! And just look at that grip! Say good-bye to sore thumbs and wrenches. Wing-Nut's built-in grip makes it a snap to splice even the hardest, heaviest branch circuit wires. New internal tension-spring coils hold splice with powerful "Python Grip". And you can see your splice is right, through the tough, semi-transparent Nylon shell. After splicing, you can clip off the wings for compact spaces. U. L. approved for aluminum-to-aluminum splices.

for branch circuits and fixtures



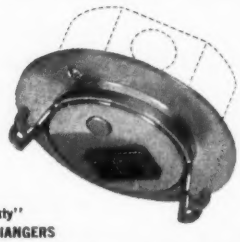
Wire-Nut®

The original! Every day, every year, more splices are made with Wire-Nuts than with any other connector. Economical, handy, easy to use. Wire-Nuts screw on easily, yet exert a tremendous grip that actually **crushes** wires together. All one piece, with rugged bakelite shell, it can't shake off. Five sizes for fixtures and branch circuits.



PULLING ELBOWS and ADAPTERS

Make wiring around corners a snap. Quick and easy to use. ½" to 2" sizes. Precision machined of malleable iron for smooth pulling, perfect 90° fit. Cadmium plated, chromate treated. Sold assembled complete with domed covers, big screws, full neoprene gaskets. Sizes marked on covers and elbows.



"Three-Sixty" FIXTURE HANGERS

The **only** hanger with choice of 10 different receptacles. Full 360° adjustment after mounting—exclusive friction ring suspension rotates all the way around. Aligns fixtures instantly, with just a twist of the wrist. Permits hanging two or four chains, or S-hooks from small compact arms. Bright cadmium plated.

your wiring jobs easier . . .

Sleight-of-hand? No, not really. Yet thousands of contractors and electricians agree there almost *is* something magic about the way the IDEAL brand on a product makes any wiring job easier.

Take wire connectors, for instance. Some of you may remember about 30 years ago when Ideal introduced the *first* screw-on connector. Today's Wire-Nuts are even better, and are standard items in just about every electrician's pocket. And now the Ideal connector line includes the exciting new Wing-Nut, and the ever-popular Crimp and Wrap-Cap.

At every step along your job, Ideal offers a helping hand. There are super-flexible fish tapes with built-in pulling reels, precision wire strippers, cable rippers, pliers, wire lubricants, voltage testers . . . There's more; but we suggest you use the coupon below to get your own private copy of the new IDEAL CONTRACTOR-ELECTRICIAN CATALOG. Then you'll see for yourself the full meaning of the little red hand down in the coupon.

Wrap-Cap®

The favorite! Some electricians say there are certain splicing jobs a crimp does best. And here's the best crimp. A cadmium plated steel sleeve, and the one-and-only Wrap-Cap "diaper" insulator. Wrap-Cap goes on in a jiffy, clinging tightly around, under and **between** the spliced wires. Absolutely no better, easier, safer crimp connector available anywhere!

IDEAL INDUSTRIES, Inc. • Sycamore, Illinois • In Canada: Irving Smith, Ltd., Montreal

SOLD THROUGH AMERICA'S LEADING DISTRIBUTORS

NEW VAP-OIL-TITE CONNECTORS

The **only** completely re-usuable connector for use with liquid-tight, flexible metallic conduit. Provides absolute water and oil-tight seal — vapor, dust, grit cannot get through. Double positive seal — exterior and interior neoprene O-rings, meet JIC standards. Assembles quickly, easily. Absolutely won't pull apart. All parts can be reused over and over again. Standard design sizes ⅜" to 1½", 2½", 3", 4".

©I. I. Inc., 1960

IDEAL INDUSTRIES, Inc.
1041-A Park Avenue, Sycamore, Illinois

IDEAL

Yes, I would like a copy of the new
IDEAL CONTRACTOR-ELECTRICIAN CATALOG.

Name_____

Title_____

Company_____

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City_____ Zone____ State_____

SPECIAL REPORT ON

PTC TRANSFORMERS

Showing WHY Electrical Engineers, Consulting Engineers and Contractors should Seriously Consider Specifying and/or Installing them on ANY Job.

THE INSIDE STORY

EVERY PRECISION TRANSFORMER IN THE ENTIRE LINE OFFERS THESE BASIC CONSTRUCTION ADVANTAGES:

1. *SPECIAL CORES*— Manufactured from high grade, non-aging grain oriented, silicon steel laminations . . . with lowest energy loss of any steel available.

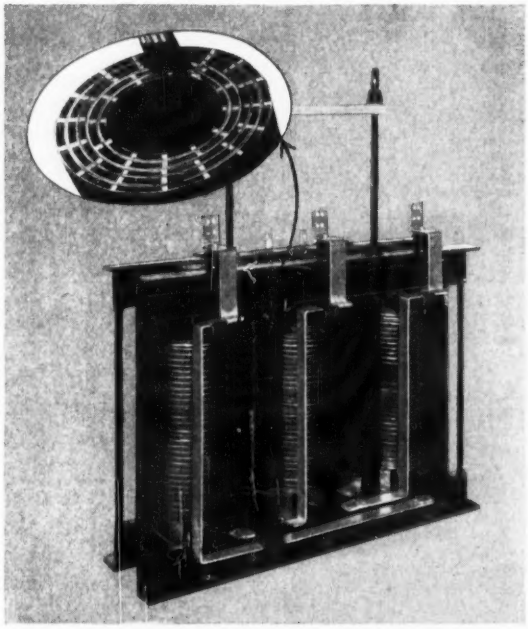
2. *EFFECTIVE COOLING DUCTS*— More efficient cooling through use of larger, exposed cooling ducts . . . Results in lower operating temperatures.

3. *RIGID CORE CLAMPING*— Core laminations are clamped together with structural steel; not formed sheet steel.

4. *GLASS LAMINATE SPACERS*— Tougher, more rigid duct spacers of glass laminate possess dimensional stability and moisture resistance many times greater than wood and paper phenolic.

5. *MORE SECURE COIL BRACING*— To resist short circuit forces and transportation hazards.

6. *SUPERIOR MATERIALS*— Insulating varnishes and enamels are selected for highest quality. Coils are made with an interlayer and interwinding insulation of Mylar-Quinterra and glass.



7. *BETTER MOUNTING PROVISIONS*— Well designed . . . easily accessible mountings . . . ample connecting space and simple wiring terminations.

PERFORMANCE RESULTS

BECAUSE PTC TRANSFORMERS ARE QUALITY BUILT, THEY CONSISTENTLY AFFORD THESE QUALITY RESULTS

1. *EXTREME QUIETNESS*—

KVA Transformer Rating	Present NEMA	Precision Average Sound Level Standard Design	Special Design
9—30	50	40	34
37½—112½	55	42	38
125—167	60	44	42
200—300	62	48	46

2. *EFFICIENCY*— Precision Transformers have the lowest operating loss of any transformer.

3. *TOP OVERLOAD CAPACITY*— Operate at lower temperatures at normal load . . . and capable of withstanding increased temperatures due to overload . . . with NO LOSS OF LIFE.

4. *RELIABILITY . . . LONG LIFE*— Fully meet all the VARYING CONDITIONS under which they must be used . . . stand up under the most severe usage.

5. *LOWER INSTALLATION COSTS*— All PTC Transformers provide neater installations at lower cost.

6. *TOTAL WARRANTY*— Unconditionally guaranteed by Precision Transformer Corp. for 5 years.

COMPLETE LINE

Whatever your transformer needs, there is a dependable, quiet, long-lasting PTC dry or liquid type transformer—more than 4,000 models ranging from ¼ to 5,000 KVA.

Included is the whisper-quiet, inside-the-wall "HUSH-FLUSH" design for schools, libraries, hospitals, churches, theatres, etc.

Write today for 4-page brochure providing details on the PTC line.

PTC TRANSFORMERS
• QUIET
• EFFICIENT
• DEPENDABLE

PRECISION TRANSFORMER CORP.
2222 West Lake Street • Chicago 12, Illinois
Representatives in all principal cities

For contractors who want the finest . . .

Phelps Dodge Habirite-Habirprene Cable with Wire Shield!

Phelps Dodge pioneered the use of a wire shield as a standard item in power cable construction. From this background and experience, Phelps Dodge developed its outstanding Habirite-Habirprene high voltage cable with a wire shield. This cable offers a number of advantages over ordinary "RR" cable with tape shield including:

1. Greater flexibility; minimum bending radius in most cases is less than half the bending radius of tape-shielded cable, making installation easier in confined areas.
2. Rugged wire shield can be braided or bunched for use as a ground lead at splices and terminations. Intermediate steps in making ground connections are eliminated, saving time and effort.
3. Dependable wire shield continuity provides protection against hidden shield rupture which can occur during installation or in service.
4. Overall wire shield resistance is constant without the variations found in tape-shielded cable.

Habirite-Habirprene cable with a wire shield assures you the utmost in safety, durability and handling ease.

See your Phelps Dodge Distributor!

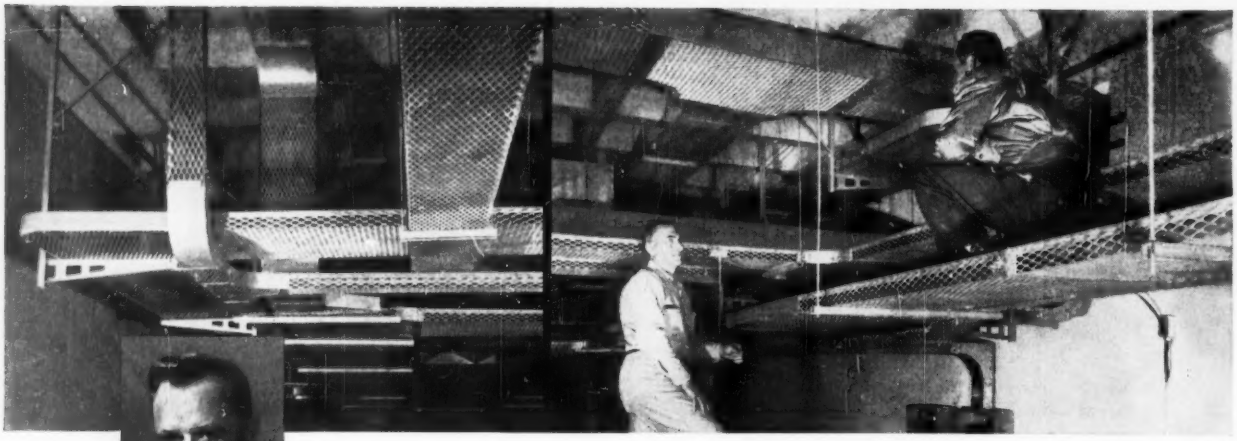
PHELPS DODGE COPPER PRODUCTS
CORPORATION
300 PARK AVENUE, NEW YORK 22, N. Y.

PD

SALES OFFICES: Atlanta, Birmingham, Ala., Cambridge, Mass., Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Dayton, Denver, Detroit, Fort Wayne, Greensboro, N.C., Houston, Indianapolis, Jacksonville, Kansas City, Mo., Los Angeles, Memphis, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., Richmond, Rochester, N.Y., San Francisco, St. Louis, Seattle, Washington, D.C.

COPE WIREWAY...

- SUPPORTS MORE CABLE IN LESS SPACE THAN CONDUIT
- CAN BE USED INDOORS OR OUT
- LIGHTWEIGHT EXPANDED METAL CONSTRUCTION SAVES TIME AND MATERIALS COSTS
- CHOICE OF GALVANIZED STEEL OR ALUMINUM
- OVER 1,000 SYSTEM COMPONENTS— STRAIGHT SECTIONS, FITTINGS, ACCESSORIES— FOR ANY PLANT LAYOUT, SIMPLE OR COMPLEX



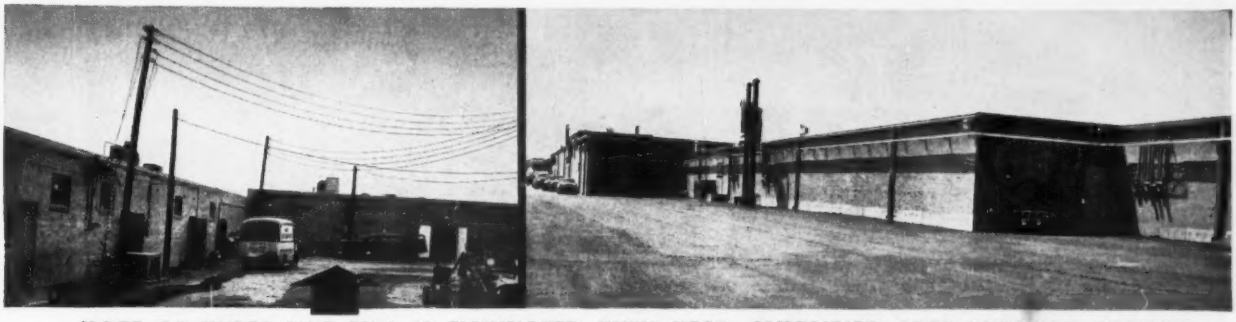
Edward Baylin, E. C. Ernst, Inc., Atlanta, Ga.

AIR TRAFFIC CONTROL CENTRE—"Difficult layout requirements posed real cable installation problems on this job," points out Mr. Baylin of E. C. Ernst, Inc., electrical contractors in Atlanta, Georgia.

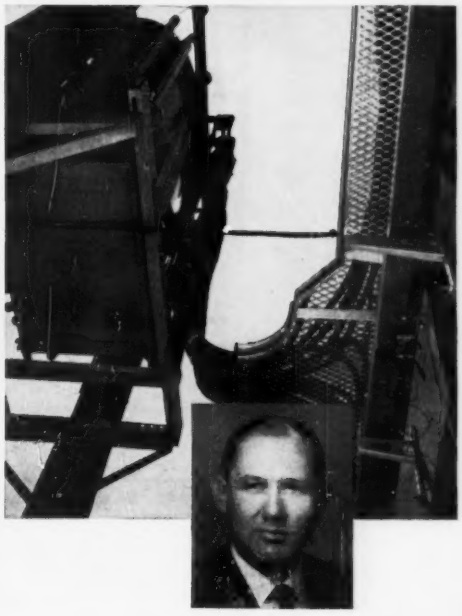
"Cope Wireway was the answer because it permitted simplified installation of strong, lightweight cable supports at *five* different elevations—for power, communication and radar distribution systems."

Ernst engineers working closely with the Cope representative and local distributor, also found that use of Cope's *complete line* of system fittings and accessories provided substantial time and materials savings.

SOLVES ANY CABLE DISTRIBUTION PROBLEM



MAZE OF WIRES LIKE THIS IS ELIMINATED WITH NEAT, SIMPLIFIED COPE WIREWAY SYSTEMS.



SOUTHWEST SHOPPING CENTER—"The architect's problem was to eliminate utility poles and cables outside a beautiful, new shopping center," reports Mr. Rowe, Sales Manager of Cummins Supply Company, authorized Cope electrical wholesalers. Cope Aluminum Wireway provides an attractive and completely weatherproof cable supporting system that eliminates the maze of wiring and low voltage connections usually associated with outdoor installations of this type.

**Henry Rowe,
Cummins
Supply Company,
Fort Worth, Texas**

COPE PRODUCTS ARE SOLD ONLY THROUGH AUTHORIZED COPE ELECTRICAL WHOLESALERS

WIREWAY | LADDER | CHANNEL

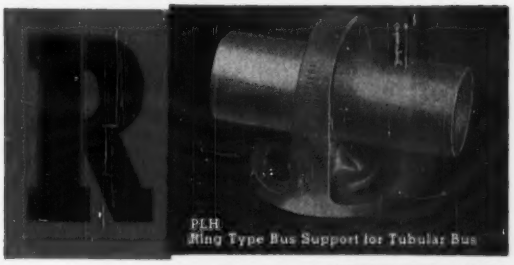
The only completely integrated line of cable supporting systems for every installation requirement . . . sold *exclusively* through authorized distributors.

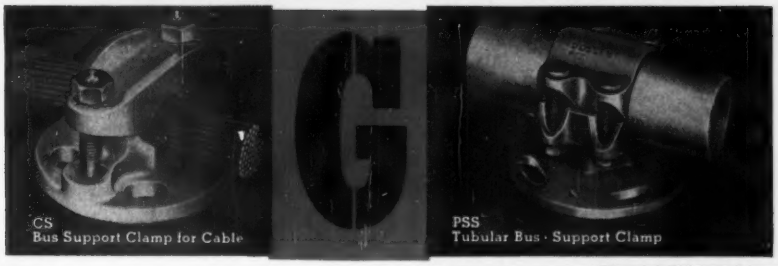
1100

COPE

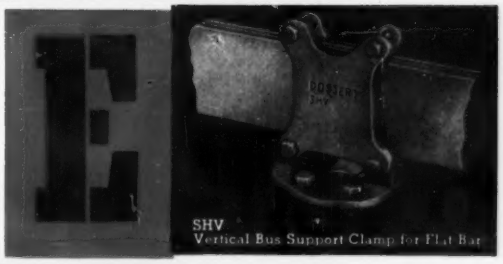
SERVING THE ELECTRICAL INDUSTRY SINCE 1885

Division of **ROME CABLE CORPORATION** • *COLLEGEVILLE, PENNSYLVANIA*





DOSSERT HIGH-STRENGTH BUS SUPPORTS



• Higher cantilever strength • Higher impact resistance
• Higher corrosion resistance • Greater durability

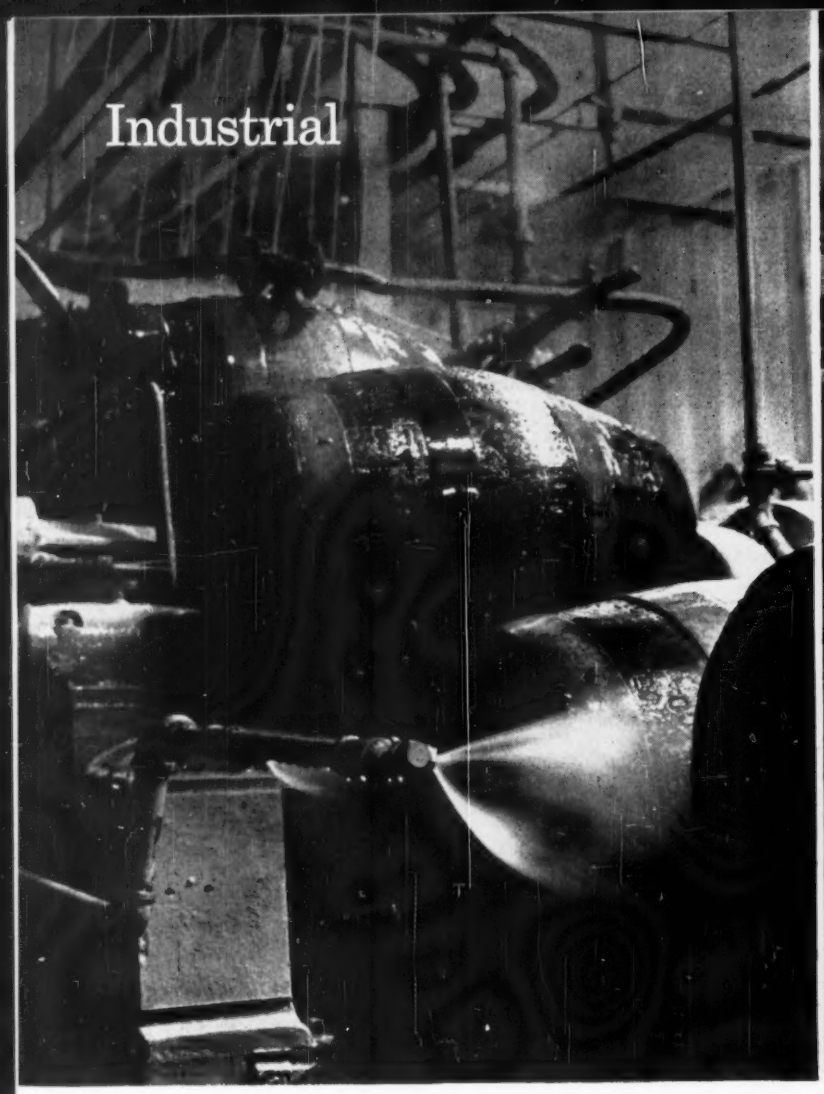
These Dossert Bus Supports are made of a high tensile strength cast bronze alloy and are equipped with silicon bronze bolts and nuts, making the entire unit completely non-magnetic. Available for all sizes and types of busses. Dossert Bus Supports can also be furnished in Coupling, Tee Connecting, Elbow Connecting, Tee Coupling and Expansion Connection types.

Special fittings and modifications can be readily supplied on short notice.

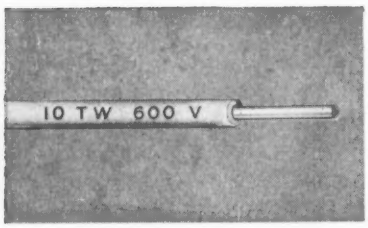
50 YEARS OF TECHNICAL KNOW-HOW

DOSSERT MFG. CORP.

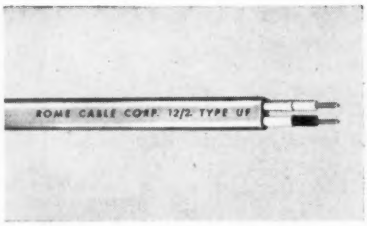
249 Huron Street, Brooklyn 22, N.Y. • Representatives in all principal cities
IN CANADA: W. S. Gerrie & Assoc., Ltd., Toronto



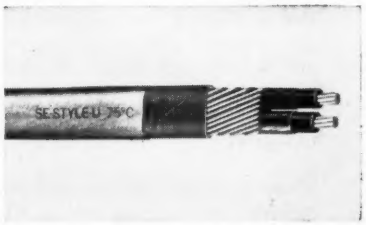
Water and insulated wire . . . do they mix?



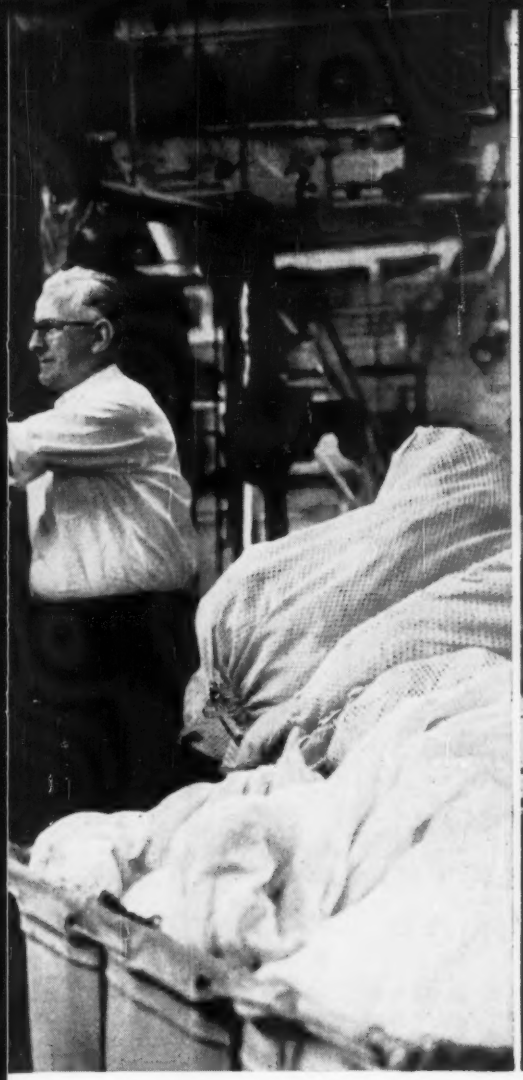
Industrial • Rome Synthinol 901 building wire —600 volts, Type TW. Polyvinyl chloride insulation, approved by U/L for use in wet or dry locations at 60 C. Also available for appliance use at 80, 90, or 105 C, depending on wire size. Synthinol 901 was used extensively for the low-voltage wiring in the plant shown here, for its proven resistance to moisture—in addition to its resistance to heat, oils and corrosives. These low-voltage applications include not only control circuits but also the general wiring of office and warehouse buildings and mill equipment. Also ideal for low-voltage circuits in refineries, chemical plants, other industrial plants where electrical wiring is exposed to extreme moisture or corrosives. For high-voltage industrial use, Rozone A (butyl) insulation is recommended.

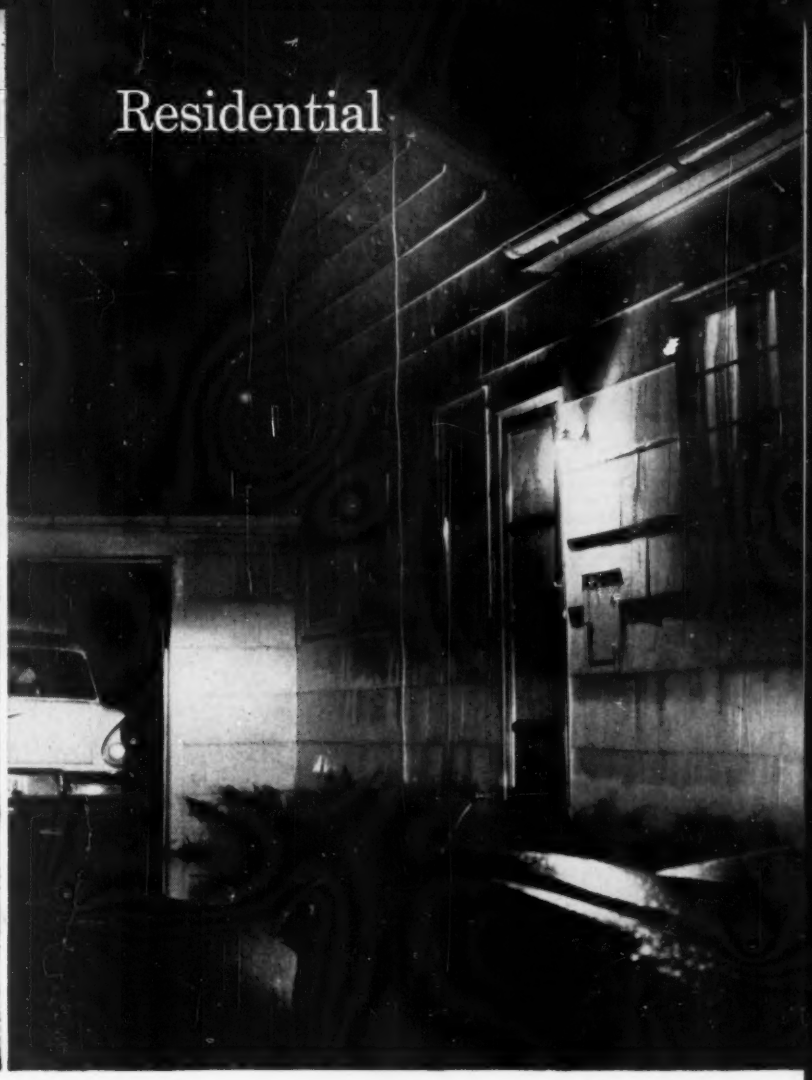


Commercial • Rome's FlexAll Type UF—600 volts, nonmetallic jacket. Insulated and jacketed with Rome Synthinol polyvinyl chloride compound. In commercial applications—such as the laundry shown here—FlexAll provides positive protection against drizzling moisture, strong detergents, acids or alkalies. Cost is low. Corrosion resistance is high. Also widely used for underground between-building wiring; farm, industrial and residential yard lighting; livestock buildings and packing houses; and for breweries, cold storage and ice plants. Available in single-, two-, or three-conductor construction. Meets NEC requirements for direct-in-earth burial and interior wiring in wet or dry locations.



Residential • Rome Type SE, Style U, Service Entrance Cables can be used for long life and high weather resistance in residential applications like the one shown here. NEC recognizes the use of this wire for attachment to the side of the building from the weatherhead to meter equipment. Conductors are insulated with a heat- and moisture-resistant RHW insulation. The insulated conductors are then given an over-all covering for mechanical protection. An appropriate neutral conductor is applied concentrically over the insulated conductors and is covered with a protective weather- and moisture-resistant tape. The final covering consists of a combined pre-saturated cotton and glass yarn braid with a gray flame- and weather-resistant finish. You can paint it to match the house. Mail this coupon!





When insulated wire is exposed to water, it's not how it *looks* but how it *works* that determines its moisture resistance.

Electrical stability of the system may be seriously impaired by water that has penetrated the insulation, causing dielectric losses. ***This can happen*** *long before you actually see any damage being done.*

At Rome Cable, work constantly goes on toward developing better compounds for moisture-resistant insulations. Innumerable scientifically accelerated tests are conducted—some last from 2 to 5 years—to determine the electrical stability of new insulations.

The greater the moisture resistance of an insulation, the less electrical properties deteriorate from long immersion in water.

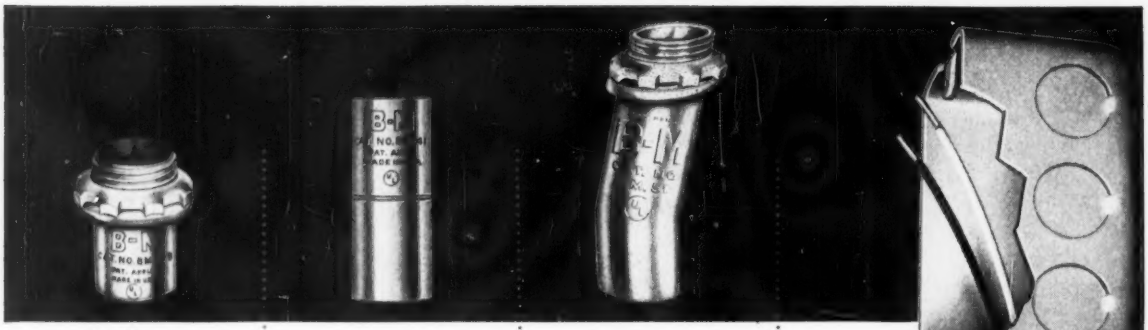
The results of these tests have aided the development of the building wires shown at the left. Rome recommends them to you as ideally suited for use in industrial, commercial and residential wiring where moisture is a problem. Mail this coupon!

ROME CABLE
DIVISION OF **ALCOA**
Department 7-10, Rome, New York

☐ Please send me more information on the above.

Name.....
Title.....
Company.....
Street.....
City..... Zone..... State.....

MEET THE MAN
WHO'S DEDICATED TO YOUR JOB
YOUR ROME CABLE SALESMAN



Red Throat
BM-21B
½" Connector
BM-22B
¾" Connector
BM-23B
1" Connector

BM-41
½" Coupling
BM-42
¾" Coupling
BM-43
1" Coupling

BM-51
½" Offset Connector
BM-52
¾" Offset Connector

BM Offset Connectors showing how wires are guided over box edge.

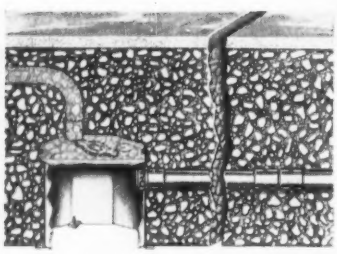
SAVE IN SIXTY

Save time and money with

B-M ORIGINAL INDENTER FITTINGS

Here is the combination that is unbeatable when it comes to easier E.M.T. installation at less cost. New lightweight plier size indenters make setting up thin wall conduit a breeze. B-M fittings are neater too! No unsightly nuts or projecting set screws.

A few more of the plus features of B-M fittings are Concrete tight—Vibration resistant—Extra heavy bright zinc plate, salt spray and acid drip tested for corrosion resistance—Extra heavy positive bonding locknuts—smooth rounded edges or bushed throat type connectors that prevent insulation damage—All steel construction with extra heavy gauge wall thickness.



ALL BRIEGEL FITTINGS ARE U. L. APPROVED AS CONCRETE-TIGHT

When setting E.M.T. in concrete you can make each job easier and more profitable by using Briegel All Steel Indenter Fittings that have UL approval as Concrete-Tight. Contractors everywhere recognize their cost cutting qualities and the fact that they make each wiring job a better job. It is only natural that Briegel Fittings are the most widely used E.M.T. connectors and couplings.

BM PLIER SIZE INDENTERS
BM—No. 607 ½"
BM—No. 608 ¾"
BM—No. 609 1"

UL

TELESCOPE BM SYSTEM

All B-M indenter type fittings far exceed the requirements of U. L. file card E 10863 and Federal Specifications W-F-406.

BRIEGEL METHOD TOOL CO.
GALVA • ILLINOIS

USED THE MOST FROM COAST TO COAST

How three companies use...

G-E Power Grooves for Sales Lighting. If your customers have products to display and sell, G-E Power Groove Lamps can play a vital role, as in the Fontius Shoe Stores, Denver, where 300 footcandles make shoe selection easy—and *fast!*

G-E Power Grooves for High Lighting Levels. Assembly Products, Inc., Chesterland, Ohio, gets 250 footcandles with mighty G-E Power Grooves— eliminated supplementary lighting, and saved *50¢ a square foot initial cost* at the same time!

General Electric Power Groove Lamps

... and get the lighting results they want

Conclusion:

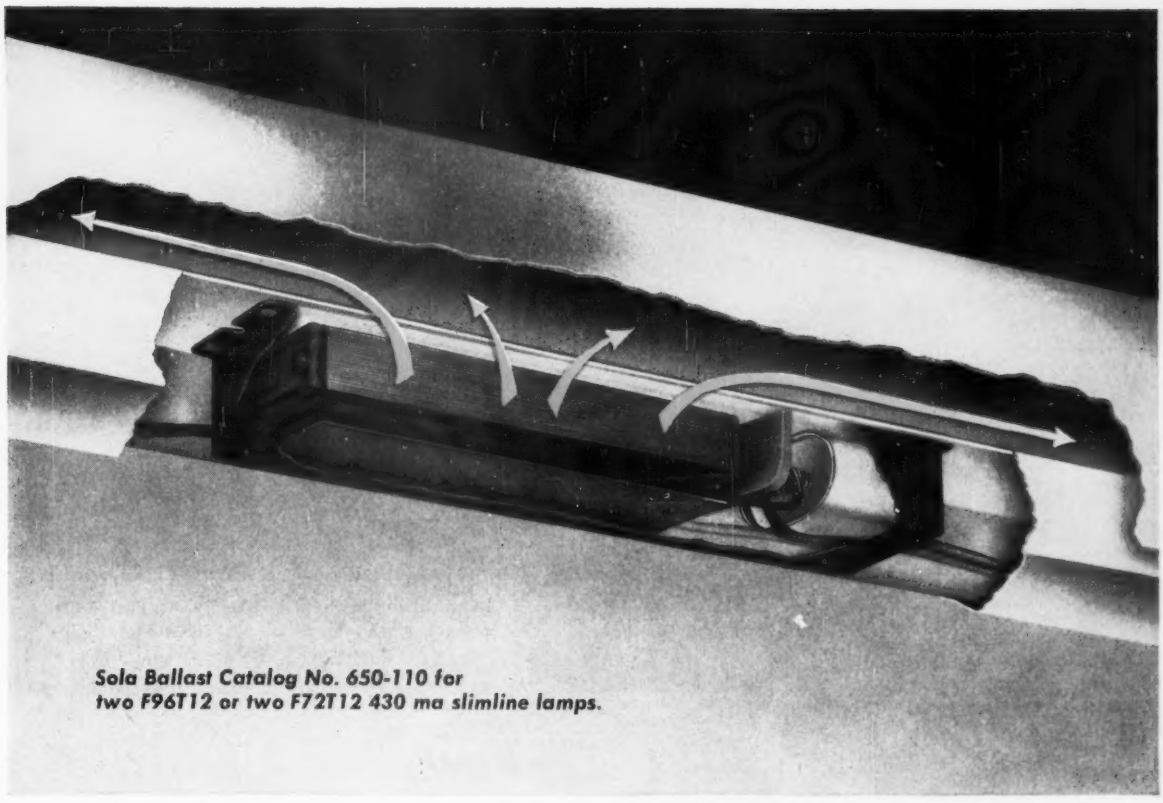
Your customers get more and more light for their money, year after year, with G-E Lamps

What kind of lighting do your customers need? Light with sales appeal? A higher lighting level? Maybe the lowest cost of fluorescent light possible? Chances are General Electric Power Groove fluorescents are the lamps they should consider. Ask your G-E Large Lamp distributor for the whole story. General Electric Co., Large Lamp Dept. C-01, Nela Park, Cleveland 12, Ohio.

Progress Is Our Most Important Product

GENERAL ELECTRIC

G-E Power Grooves for Low Initial Cost. In Murray Hill, New Jersey, Bell Laboratories specified 100 footcandles in this engineering office and got it most economically with General Electric Power Groove Lamps.



Sola Ballast Catalog No. 650-110 for two F96T12 or two F72T12 430 ma slimline lamps.

Upside-down insides make Sola's new slimline ballast work cooler, dissipate heat faster

Heat, the big enemy of fluorescent ballasts, is well on its way out thanks to a simple but extremely effective move by Sola ballast engineers. They mounted the components of their slimline ballast *upside-down*. This allowed them to remove the fiber insulator from the mounting surface of the ballast case. Now positioned beneath the label surface, it can't trap heat inside the case.

The normal heat generated by the core and coil is transmitted directly to the fixture housing where it is quickly conducted away. The fixture itself acts as a big cooling fin for the ballast. Additionally, a healthy margin of extra space is provided between the capacitor and the core and coil. This extends capacitor life.

All this adds up to a premium ballast that operates cooler, works more efficiently, and lasts longer. Despite this, it costs no more than conventional, hotter-running ballasts. You get premium performance now at no price penalty. The new ballast is CBM-certified to give full light output over its rated life.

You would be wise to capitalize on Sola's upside-down act when you next need ballasts for quality fluorescent fixtures, or for replacement where other ballasts gave up.

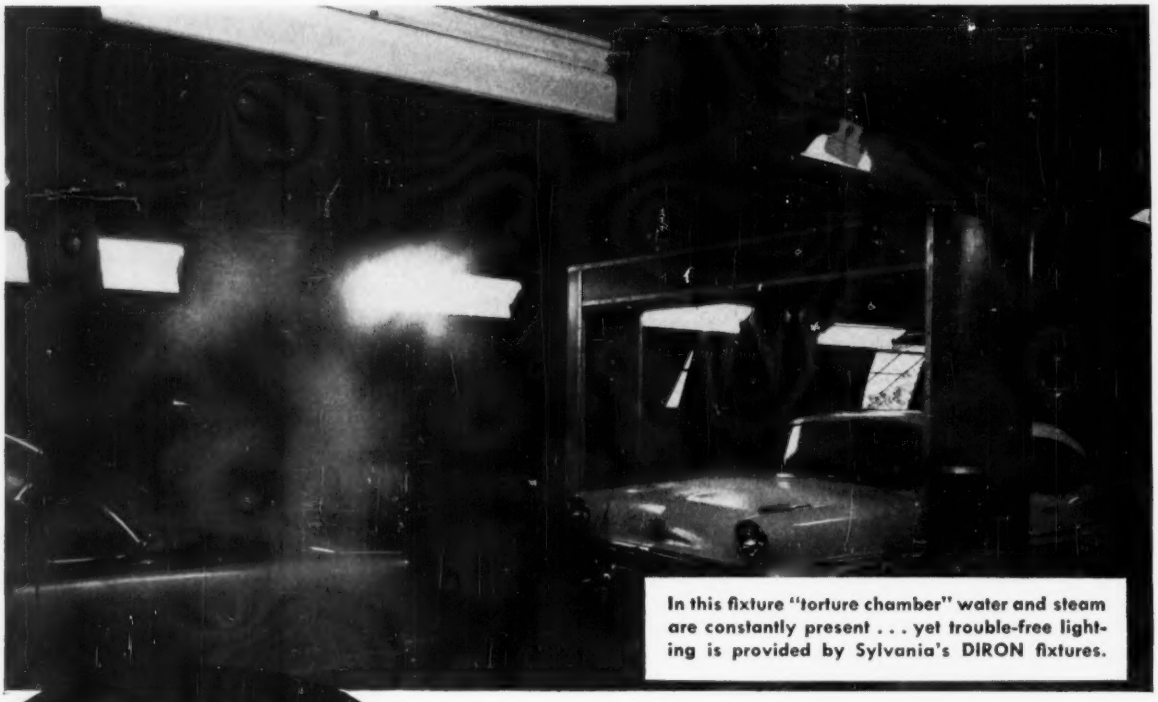
Write for Bulletin 26A-FL

SOLA

B P C

A DIVISION OF BASIC PRODUCTS CORPORATION

SOLA ELECTRIC CO., 4633 W. 16th St., Chicago 50, Ill., Bishop 2-1414 • In Canada, Sola Electric (Canada) Ltd., 24 Canmotor Ave., Toronto 20, Ont.



In this fixture "torture chamber" water and steam are constantly present . . . yet trouble-free lighting is provided by Sylvania's DIRON fixtures.

now... *True All-Porcelain Fixtures for Extreme Humidity Conditions*

Sylvania's New DIRON Fixtures

Here is a new, important advancement in fluorescent lighting fixtures . . . especially for textile mills, laundries, tanneries and other high humidity locations.

Selected Sylvania fixtures—both industrial and open-type—now have the new DIRON finish, a super-thin, all-porcelain process.

Every external part of these fixtures—*even the lampholder cases* for multi-lamp units—is protected against moisture by this exclusive DIRON process.

By this new method a tough, durable layer of porcelain is applied to *all* exposed surfaces of the fixtures. Yet the finish is so strong and pliable that knockouts can be removed without damaging the porcelain protection.

You'll find these fixtures both practical *and* economical. The new DIRON fixtures cost much less than conventional all-porcelain units. And the price is so close to that of standard industrial fixtures that you'll want to use DIRON units when there is any chance of a high humidity or corrosive atmosphere.

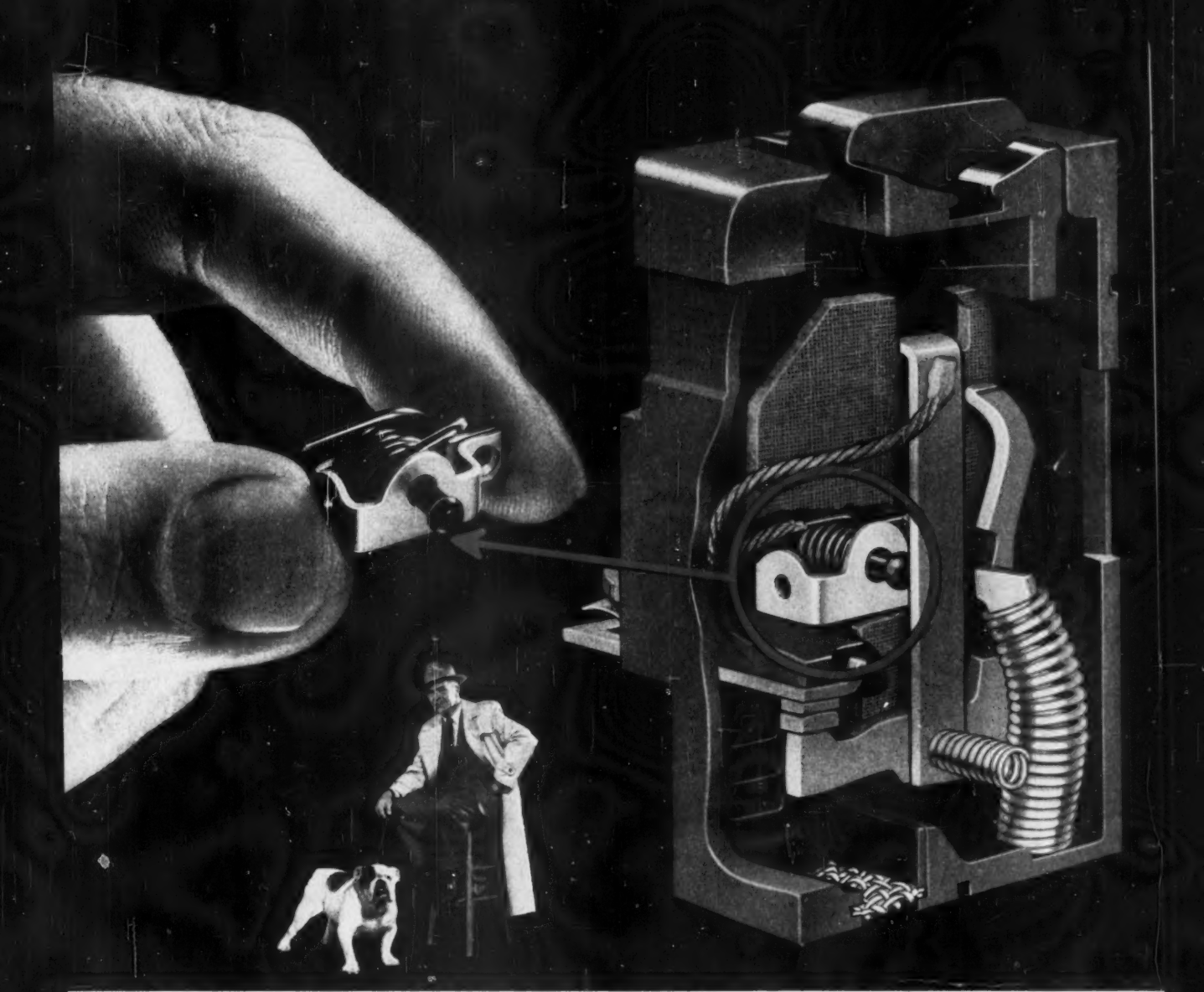
For full information on Sylvania DIRON fixtures, write to:

SYLVANIA LIGHTING PRODUCTS
A Division of SYLVANIA ELECTRIC PRODUCTS INC.
One 48th Street, Wheeling, West Virginia

GO MODERN WITH LIGHTING BY SYLVANIA

Subsidiary of
GENERAL TELEPHONE & ELECTRONICS

FLUORESCENT LIGHTING FIXTURES AND SYSTEMS • BEST FIXTURE VALUE IN EVERY PRICE RANGE



NO TROUBLE CALLS WITH PUSHMATIC

coil protection is standard in every breaker

Protect branch circuits against high overloads and "flash-shorts" with Pushmatic magnetic coil action! BullDog, the first to offer this protection in 15-amp and 20-amp ratings seven years ago, builds this safeguard *into every Pushmatic® breaker.* The solenoid (coil) —coupled with the thermal element— provides *double* circuit safety. Makes trouble calls a thing of the past.

As you can see in the above picture the Pushmatic uses a *multi-turn coil.* High overloads or "flash-shorts" instantly set up a magnetic field in the coil—causing the metal plunger to trip the latch and break the circuit. BullDog Pushmatics provide not only maximum branch circuit protection, but protect lamp and appliance cords, too!

Small overloads are taken care of by the thermal-bimetal latch. An overloaded circuit will heat the bimetal which curves, releasing the latch. A built-in time delay prevents nuisance tripping in case of harmless overloads.

Protect your branch circuits with proved Pushmatic coil action! Each and every Pushmatic is rigidly tested to assure precision operation. You'll find Pushmatic double protection pays off! Multi-turn coils are standard in all Pushmatics — 15 amperes through 50 amperes.

BULLDOG ELECTRIC PRODUCTS DIVISION
I-T-E CIRCUIT BREAKER COMPANY
BOX 177 • DETROIT 32, MICHIGAN

®

In Canada: 80 Clayson Rd., Toronto 15, Ont. Export Division: 13 East 40th St., New York 16, N.Y.

SPANG HD Conduit's uniformity provided easy, accurate threading and considerable time saving on the Georgia Power Company job.

"SPANG HD STEEL CONDUIT works up 5% faster than even its best competitors!"

says Mr. H. G. Millican, President, Millican Electric Company, Atlanta, Ga.

"We installed 23 miles of SPANG HD steel Conduit in the new Georgia Power Company Building in Atlanta," reports Mr. Millican.

"The speedier installation, which saved us considerable time, is due to the uniformity of SPANG Conduit. The hot-dipped galvanized finish is even. SPANG bends very easily and dresses out nicely. We had no problems of damaged wire from wire pulling.

"The bundling which SPANG uses makes a neat package. It's a tight bundle, easy to transport, stack for storage and handle on the job.

"Certainly, I'd recommend SPANG," concluded Mr. Millican. "My best recommendation is that I use it!"

Architect: Stevens & Wilkinson, Atlanta
General Contractor: Beers Construction Company, Atlanta
Electrical Contractor: Millican Electric Company, Atlanta
SPANG Distributor: The Electric Supply Company, Atlanta

23 miles of SPANG HD go into Georgia Power Company job

Finishing touches are applied to the Georgia Power installation. Note that fluorescent fixtures are suspended from the strong steel conduit runs.

The new Georgia Power Company $4,250,000 general service headquarters building covers 387,350 square feet of floor space. It's one of the largest electrically heated buildings in the southeast.

Twenty-three miles of SPANG HD Steel Conduit protect the wiring which services the electric heating, fluorescent and incandescent lighting, and general power requirements. The fluorescent fixtures on this job are suspended from SPANG Conduit runs, demonstrating the strength of steel conduit.

This new Georgia Power Company building, which will serve the company's service area, includes a garage, general stores and warehouse, salvage department, appliance repair shops, meter shop, laboratory, and general repair shop.

Want quality? Specify SPANG!

Your local SPANG Distributor carries the complete line of SPANG Steel Conduit and fittings, and SPAN-GLEAM EMT. Call him for top-quality service!

SPANG® CONDUIT

THE NATIONAL SUPPLY COMPANY

Two Gateway Center, Pittsburgh 22, Pennsylvania

Subsidiary of Armco Steel Corporation ARMCO®

"Equal to RLM" ...Anyone can Say it!

BUT

Only the RLM LABEL can GUARANTEE IT with a continuous RLM Test Program of Inspections by the ELECTRICAL TESTING LABORATORIES

"Equal to RLM" is a claim that is often made by sellers of industrial lighting equipment. No finer compliment could be made to the high quality RLM specifications!

However, RLM is more than a group of widely approved standards for industrial lighting equipment. RLM is also a guarantee of conformance. This guarantee is backed by the unbiased tests conducted by an independent testing laboratory—The ELECTRICAL TESTING LABORATORIES OF NEW YORK! These tests assure not only compliance with standards but every effort is made to insure that *every fixture* shipped to the buyer will be of uniform quality.

In the entire lighting industry there is no equal to this testing program... so in the truest sense there can be no such thing as "equal to RLM." RLM is unique... distinctive and above price to the buyer who wishes unbiased proof of quality.

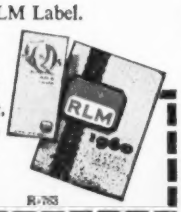
THE FINAL INGREDIENT

OF BEING SURE

Into each factory go ETL representatives to secure for test and certification purposes, samples of the manufacturer's RLM-labeled units.

PRODUCT QUALITY
LIGHTING QUALITY

These TWIN QQ's to Industrial Lighting Success
are guaranteed with all lighting equipment bearing the RLM Label.
Return of the coupon brings you full information.



RLM STANDARDS INSTITUTE, Suite 6191, 326 W. Madison, Chicago 6, Ill.

Please send me free a copy of the new "TWIN QQ's" pamphlet, the latest RLM SPECIFICATIONS BOOK, and names of the leading manufacturers offering RLM-labeled lighting equipment. (Please write name, company and address in margin below.)

R-763

WHERE CONTINUOUS POWER IS A "MUST"—

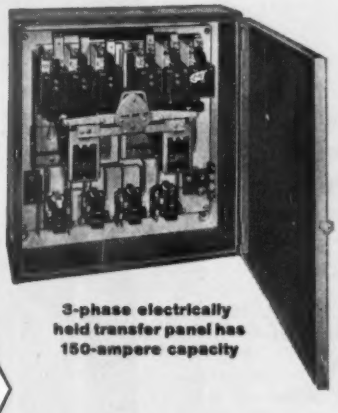
USE

SQUARE D TRANSFER PANELS

• When power fails, transfer panels automatically switch a lighting or power load from the normal source to an emergency source. Often they are a legal "*must*" in churches, department stores, hospitals and other places where public safety is involved. They are also invaluable in radio stations, where expensive tubes must be protected from fast cool-off —in factories, where certain processes must not be interrupted—in any location where power failure can cause accidents or property damage.

Regardless of your application, you can get exactly the transfer panel you need from Square D. They are available for lighting systems up to 480 volts and 300 amperes, and for 600 volt power systems up to 200 hp. Your choice of electrically or mechanically held versions.

***Write** for the complete story of Square D Automatic Transfer Panels. Address Square D Company, 4041 North Richards Street, Milwaukee 12, Wisconsin*

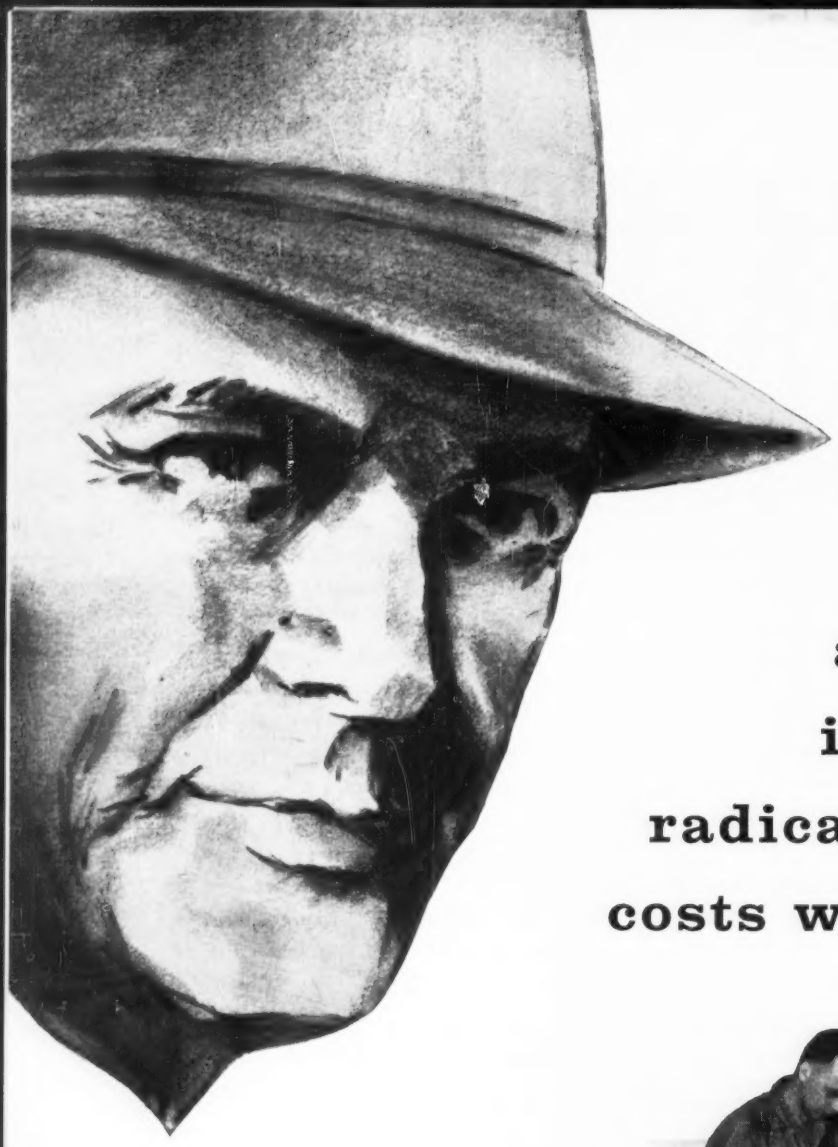


3-phase electrically held transfer panel has 150-ampere capacity

Mechanically held 30-ampere transfer panel for tungsten lighting loads

SQUARE D COMPANY

wherever electricity is distributed and controlled



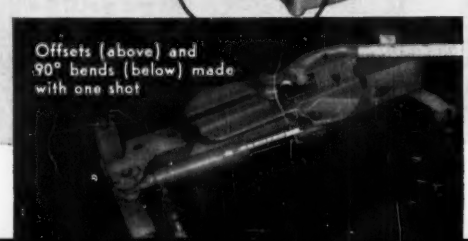
Look at how contractors are speeding installations, radically reducing costs with Greenlee

JOB-

As the bidding gets tighter and the profit squeeze grows tougher, today's smartest contractors are "tooling up" in every practical way to streamline operations — *control* costs!

Many are finding the answer in *Job-Profit Tooling* by Greenlee. It saves costly materials, mechanizes much of the work previously done by hand — assures extra efficiencies, better final results, *more net profit per job!*

To illustrate—the new Greenlee Multi-purpose Hydraulic Bender at right makes offsets *in seconds* with one setting, one shot. Other Greenlee Job-Profit Tooling ideas to bring you additional time and materials savings are shown on the facing page.



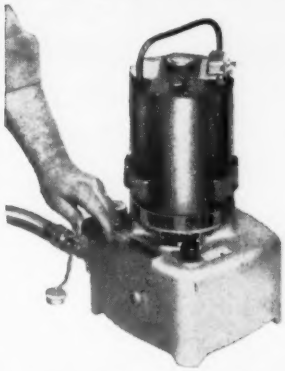
Offsets (above) and 90° bends (below) made with one shot

IDEA FOR FAST, ON-THE-JOB CONDUIT BENDING—Greenlee No. 884 Lightweight Hydraulic Bender with portable power pump, shown above, makes 90° bend in 4" conduit in about four minutes with one shot. Handles ½"-4" sizes of steel and aluminum conduit and pipe.

Greenlee Lightweight Hydraulic Benders are also available in two other models: No. 880-M2 for ½"-2", and No. 883 for ½"-3" conduit and pipe. No. 880-M2 with power pump makes 90° bend in 2" conduit in less than a minute. No. 883 with power pump makes 90° bend in 3" conduit in about a minute.

All models make full 90° bend with one ram stroke and are easily operated by one man with hand or power pump. Portable . . . carried by one man or wheeled from job to job on pipe supports which serve as rollers. Conduit is easily inserted and removed from front of bender . . . "Quick-Removal," positive-locking support pins cannot come loose. Attachments also available for bending thin-wall, bus bar, and tubing.

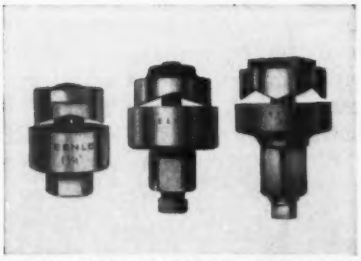
The Greenlee line also includes segment-type hydraulic benders, hand benders, and ratchet hand benders to give you a full complement of tooling for speeding every conduit-forming job.



IDEA FOR FASTER BENDING—Convert from hand to power pump. Many contractors are finding the value of power operation over their previous hand-operated equipment. Power pumps increase bending speed from 3 to 5 times. A complete line of power pumps available with electric motors or gasoline engines. Illustration above shows the popular 798 AC-SA pump with ¾ hp, 110-220 volt a-c motor.

IDEA FOR CUTTING CONDUIT OPENINGS WITH NO PRE-DRILLING OR STEP-UP PUNCHING—Save yourself many dollars on conduit installations with Greenlee One-Shot Knockout Punch Driver that features high-strength aluminum "C" frame which fits around a junction box. Fast one-man setup and operation . . . lightweight and powerful. Punch cuts through 10-gauge steel with few strokes of hydraulic pump handle. Two sizes: No. 1732 (above) punches holes for ½"-4" conduit, No. 1731 also available to punch holes for ½", ¾", 1" conduit.

PROFIT TOOLING



IDEA FOR FASTER RESULTS ON ALL KNOCKOUT PUNCHING JOBS—With a Greenlee Hydraulic Knockout Punch Driver holes are made in seconds for conduit up to 5". This operation is many times faster than the wrench method, and cutting is possible in cramped quarters—no wrench space needed. Your timesavings can quickly pay for this highly efficient tool. Designed to drive all Greenlee knockout punches, it is available singly for punches already owned or in handy sets with 6 or 10 punches.

Greenlee makes a complete range of knockout punches for conduit ½"-5". Fast, easy cutting through 10-gauge metal. Every cut is quick, clean—slug falls free in die. No. 735 set in leather case for ½"-1¼" sizes; No. 737 set in leather case for 1½" and 2" sizes. Other sizes individually packaged.

Job-Profit Tooling by Greenlee includes more than 100 different types and sizes of timesaving equipment specifically developed for the electrical worker. To help you select those that will "tool up" your operation for better job profit, write today for new illustrated quick-reference Bulletin E-240.

GREENLEE TOOL CO.
1878 Columbia Ave., Rockford, Ill.

TOOLS FOR CRAFTSMEN
GREENLEE

JOB-PROFIT TOOLING

...cost control for contractors

HERE'S A BRAND NEW WAY TO

HOUSEPOWER PROFITS, MR. CONTRACTOR

In national magazines • On national network television

The public is being told that *YOU* are the man to call for Full HOUSEPOWER!

Full color ads sponsored by Edison Electric Institute

One-column ads sponsored by National Wiring Bureau

Full color ads in *Better Homes & Gardens* will emphasize *full* HOUSEPOWER. Right next to them, special one-column ads will direct the reader to you, Mr. Electrical Contractor.

The full color ads will be made into four-page folders which you can mail to customers . . . and a series of ad mats—just like the one-column national ads in *Better Homes & Gardens*—will be ready for you to run over your own name.

And, all through the year, Edison Electric Institute will be running more full color ads in national magazines – ads designed to make people want the advantages they can get only when they have the *full* HOUSEPOWER you can give them!

In addition . . . commercials on day-time network TV will demonstrate to housewives how *full* HOUSEPOWER gives them and their families more fun . . . more convenience . . . more comfort.

HERE'S WHAT YOU DO

1. Check with your electric utility or electric league. Find out their plans for helping you to profit from this great HOUSEPOWER campaign.

2. Visit your distributor's HOUSEPOWER Idea Center. There you will find a multitude of new profitable product promotion ideas.

3. *WRITE NOW* for your free copy of a step-by-step campaign guide entitled "A Treasure Chest of HOUSEPOWER Profits." It gives full details on how you can identify yourself and your business with this campaign.

NATIONAL WIRING BUREAU

155 East 44th Street, New York 17, New York

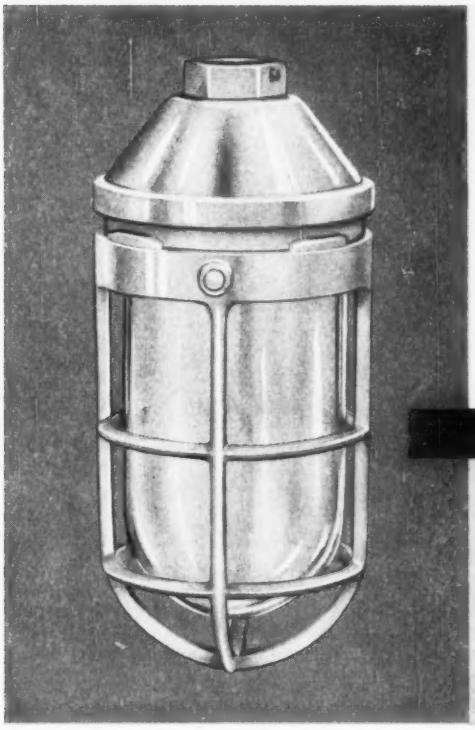
. . . a sponsor of

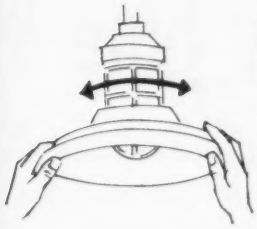
HOUSEPOWER

NEW PYLE ALUMINUM VAPORTIGHT LIGHTING FIXTURES

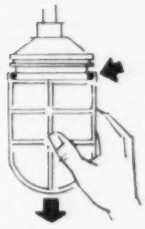
COATED WITH PEC-9 FOR THE TOUGHEST JOBS

Resists salt spray, acid fumes, strong caustics and organic liquids (no extra price).





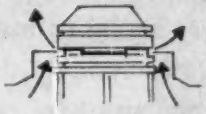
Reflectors, removable by a 45° turn without tools for convenient cleaning, have four self-locking nylon shoes.



Guards with stainless steel ball detents removable without tools for convenient lamp changing independent of reflector.

no tools required for re-lamping and cleaning

Fixture rigidly secured to pendant. Thread cannot be loosened when removing guard, globe or reflector.



Air flow through reflector keeps fixture cooler, cleaner and brighter.

Simplified Maintenance—New materials, design and reliability!

- Material: Die cast aluminum components. Heat resistant globes are standard in a choice of colors. Specification grade porcelain lamp holder and all-white porcelain enameled reflectors.
- Design: Interchangeable straight and 90 degree bracket mounting adapters fit both 100 watt and 200 watt fixture sizes. Lamp holder gasket seals off wiring and lamp compartments.
- Corrosion-resistant PEC-9 white coating furnished as standard eliminates need for application of special compounds in the field to protect metal components against salt spray, acid fumes, strong caustics and organic liquids.
- Dome, shallow bowl, deep bowl and 30 degree all-white reflectors greatly enhance the appearance of the fixture wherever installed.

Fixtures are U/L and CSA approved and meet Navy, Corps of Engineers and General Service Administration specifications.

Get the full facts. Write for detailed information or call your Pyle authorized distributor.

THE PYLE-NATIONAL COMPANY

SINCE 1897

WHERE QUALITY IS TRADITIONAL

1344 North Kostner Avenue, Chicago 51, Illinois

Subsidiary: PYLE-NATIONAL (CANADA) LTD., Toronto 15, Ontario
Railroad Export Dept.: International Railway Supply Co., 30 Church St., New York 7, N. Y.
Industrial Export Dept.: Lionel-Essex International America Inc., 15 E. 26th St., New York 10, N. Y.

CONNECTORS • CONDUIT FITTINGS • CIRCUIT CONTROLS • LIGHTING FIXTURES • FLOODLIGHTS

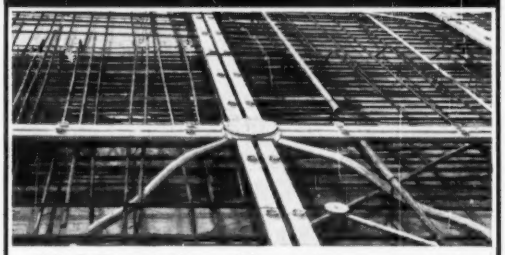
There's a General Electric Underfloor Wiring System to meet every electrical requirement ... for any type of floor construction

Practically any combination of structural and electrical specifications can be met by using one of General Electric's four steel underfloor wiring systems. For all types of floor construction ... slab and fill, monolithic, lift slab, steel deck, wire mesh form ... you can pick a G-E system that perfectly matches the application. And no matter what the electrical requirements ... high density power wiring or a maze of telephone lines ... you'll find that a G-E system can take care of the job and still have plenty of room left for additional wiring later on.

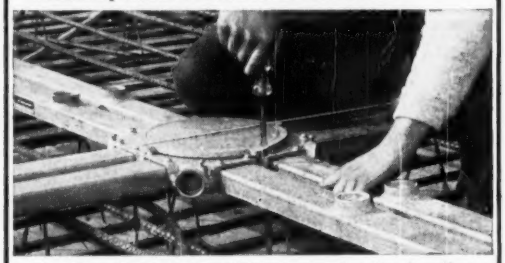
Installation is simple, too. That's because all four G-E systems are straightforward in design and accurately made to close tolerances. The components fit together without difficulty—save time on the job, and give long-term reliability.

All four G-E systems are listed by Underwriters' Laboratories, Inc., and meet Federal Specifications.

G-E UNDERFLOOR WIRING SYSTEMS ARE EASY TO INSTALL



All G-E underfloor wiring systems are easy to install. For example, with the G-E single-level systems all duct runs may be fed through conduit openings in the corners of the boxes—no need for field adaptations to feed center duct runs.

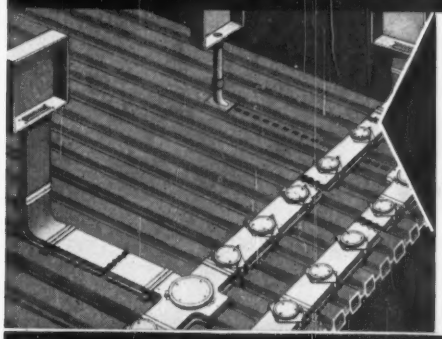


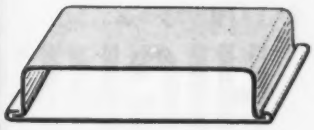
Another important point: screws in the leveling ring of all G-E single-level junction boxes permit fine adjustments to bring the box level with the fill—without need of removing the box cover.

Progress Is Our Most Important Product

GENERAL ELECTRIC

FOR CELLULAR-STEEL FLOORS



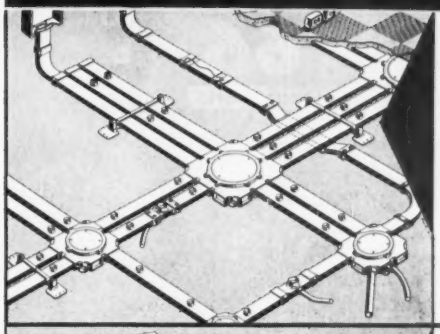


G-E HEADER DUCT
9.03 SQUARE INCHES
INTERIOR
CROSS-SECTIONAL AREA

The G-E cellular-steel floor wiring system makes it possible to locate outlets in every 6 inches of floor area. A special capped header allows you to provide for future expansion at low initial cost.

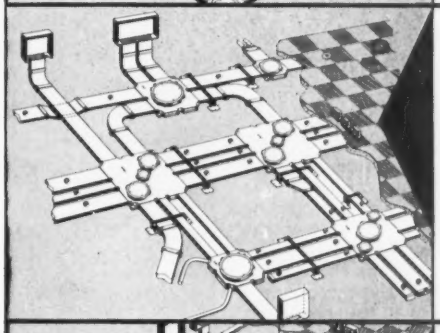
G-E header duct offers 9.03 square inches interior cross-sectional area to provide for ever-increasing electrical needs, will accommodate 110 No. 14 Awg wires in accordance with the National Electrical Code.

FOR CONCRETE FLOOR CONSTRUCTION



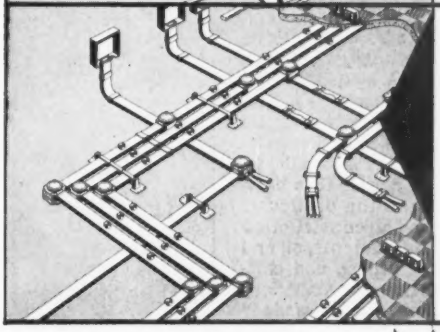
SINGLE-LEVEL
STANDARD DUCT
3.357 SQUARE INCHES
INTERIOR
CROSS-SECTIONAL AREA

In standard layouts—The G-E single-level steel standard duct system offers up to 3 services. Supplementary feeding through conduit is possible through corners of durable, cast-iron junction boxes. These boxes afford easy leveling and cover adjustment, and provide large openings for wire pulling. Compartments are available to separate services in double and triple boxes. Can be installed in fill as shallow as 2½". Duct will accommodate 41 No. 14 Awg wires, in accordance with the National Electrical Code.



SINGLE-LEVEL BIG DUCT
8.414 SQUARE INCHES
INTERIOR
CROSS-SECTIONAL AREA

For greater feeding capacity—G-E single-level steel BIG DUCT system with an 8½" cross-sectional area will accommodate 102 No. 14 Awg wires. System includes boxes, components, and accessories necessary to use BIG DUCT either by itself or with G-E single-level standard duct. Can be installed in any type of floor that has a minimum fill thickness of 3 inches.



TWO-LEVEL DUCT
4.007 SQUARE INCHES
INTERIOR
CROSS-SECTIONAL AREA

For difficult feeding problems—The G-E steel two-level duct system is recommended for fills of 3½" and over, particularly where feeding must be accomplished from many locations. It allows complete separation of services. All feeding is done by duct on the lower level, distribution on the upper level. Ducts bypass intervening junction boxes; need for conduit home-runs is eliminated. Will accommodate 49 No. 14 Awg wires, in accordance with the National Electrical Code.

For valuable manuals containing complete layout, design, product, and installation data, mail the coupon today

The General Electric Company
Conduit Products Department, Section CU-88A-918
Bridgeport 2, Connecticut

☐ Please send me your bulletin on single- and two-level steel underfloor wiring systems.

☐ Please send me your bulletin on cellular-steel floor wiring.

☐ Enclosed is a description of my underfloor wiring problem. What do you suggest?

Name _____ Title _____
Company _____
Address _____
City _____ Zone _____ State _____

59TH YEAR • JANUARY, 1960

ELECTRICAL CONSTRUCTION AND MAINTENANCE

Frontiers for the 60's

At the beginning of a new decade, it's a good idea to lean back, take off the spectacles that keep the details of the current scene in sharp focus and upon the less distinct but more plastic shapes that remain, erect a tentative structure of things to come. In an evolving industry the imminence of change is reality, and if we can anticipate the probable future, we are better prepared to contend with it. The following thoughts are dedicated to that end.

The electrical industry will move aggressively into a much greater and perhaps decisive role in space heating in the next ten years. The inherent simple adaptability of electric heat to space under precise control with a minimum of architectural or structural limitation will be more compelling in system selection. Buildings will be heated, as they are now lighted, with electrical components appropriate to the space and occupancy.

Cooling will become practically universal even in areas where it is not now considered necessary. The substantial growth in electrical loads, for lighting and other purposes, will help to dictate the adoption of cooling and heat exchange equipments. Within the coming decade, there is a good chance that static thermoelectric junction devices, which cool and heat directly in response to a current flow, will reach the commercial market.

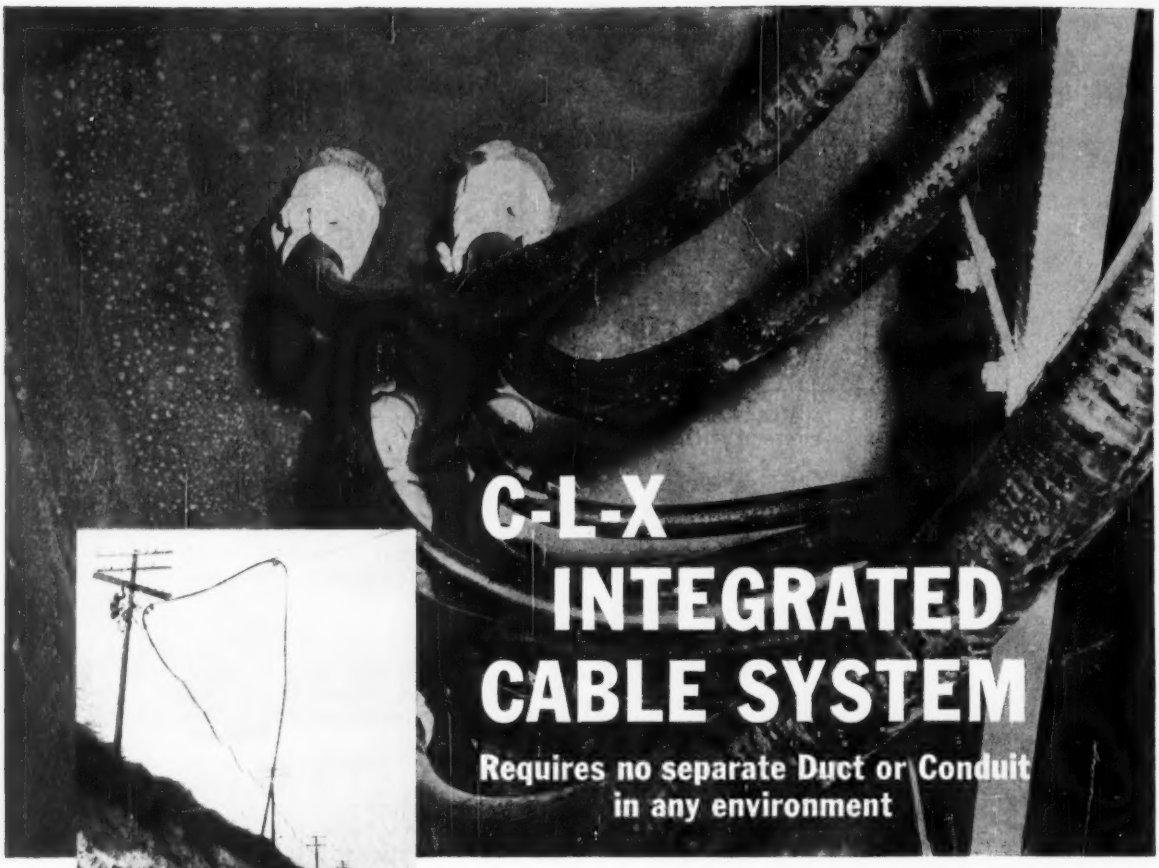
Air cleaning, particularly electrostatic, will take on new significance and importance in future buildings. It will be compelled by plain economics. The mounting costs of maintenance and of decorations, the impairment of costly lighting systems by dust, the losses from damage to soft goods, and the improvement in employee working conditions will all dictate a sophisticated attack on air borne dirt and contaminants. The attack will be two-fold—at the source and in the buildings we occupy.

Lighting practice can be expected to involve more than double present footcandle values and much more consideration for brightness ratios and reflectance values of materials and surfaces in the areas lighted. Color, and the coordination of light and color, will become increasingly important in the lighting systems of the immediate future. Heat, from the lighting system and its auxiliaries, may become an important and, possibly, aggravating problem.

Centralized control of electrical systems operation will become routine in the near future. Automatic or program operation will take over control of most of the lighting, power, heating, cooling and other electrical equipment serving our buildings. Sensitive systems will also take over most internal security, patrol and surveillance functions.

In electrical systems we can expect pretty general adoption of higher utilization voltages, typically 277/480, and higher distribution voltages. High capacity, low impedance system requirements will compel closer attention to overcurrent interrupting capacities and their effective coordination. More attention will be directed, too, to fault-path impedance considerations and grounding practices to insure not only continuity but sufficient capacity to provide for effective operation of overcurrent devices.

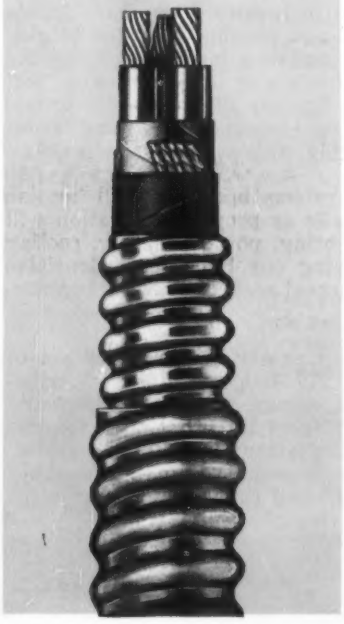
Wm. T. Stuart



C-L-X INTEGRATED CABLE SYSTEM

Requires no separate Duct or Conduit in any environment

Unusual pliability of C-L-X Sheathed Cables is shown here as the cable is being installed.



The revolutionary C-L-X Continuous, Corrugated, Lightweight, metallic sheath, that Simplex introduced to this country two years ago, is now available in *Aluminum*, *Copper* or *Bronze* as well as the enormously successful *Steel*.

Simplex C-L-X pliable cable systems provide unexcelled ease of installation and mechanical protection.

The *corrugated* metal sheath combines pliability for ease of installation with very great strength and seals the cable against penetration by oil, chemicals and moisture.

Depending on the environmental conditions of the installation, these power, control and communication cable systems can be furnished with or without plastic jacketing.

Light, and pliable, C-L-X cables are easily installed, and require no special reels.

Now, with corrugated *Aluminum*, *Copper* or *Bronze* sheathed C-L-X cable systems, the low resistance of these metals permits designs where the sheath may be used as a neutral or ground. These metals also permit the use of single as well as multiconductor cable assemblies in a-c power systems.

For complete details on C-L-X sheathed cables, contact your Simplex Engineer, or write direct.

See C-L-X in Steel, Copper and Aluminum at the PLANT MAINTENANCE SHOW BOOTH NUMBER 212

Simplex

WIRE & CABLE COMPANY

79 Sidney Street, Cambridge, Massachusetts

Outlook for 1960

Department of Commerce forecasts show new construction up moderately in 1960. Analysis of electrical work prospects indicate better than average gains are in store for the industry this year.

Electrical Work

(millions of dollars)

	1958	1959[1]	1960[2]
Private Funds			
Residential	754	890	860
Industrial[3]	368	330	440
Commercial and Institutional	773	847	1019
Utilities[4]	437	375	396
Farms	91	96	93
Other	8	8	8
Total Private	**2431**	**2546**	**2816**
Public Funds			
Residential	27	33	32
Industrial	59	58	67
Educational	384	350	385
Institutional	93	171	201
Military	31	40	41
Highway and conservation	270	282	318
Other	18	17	18
Total Public	**882**	**951**	**1062**
Total New Work	**3313**	**3497**	**3878**
Modernization and Repair[5]	**920**	**1050**	**1200**
Total	**4233**	**4547**	**5078**

Notes:
1. 3rd quarter estimated.
2. Estimated.
3. Does not include motor, controls or electrical equipment which are part of machines or manufacturing processes.
4. Does not include electrical apparatus used in generation and distribution nor communication equipment.
5. Does not include replacement lamps.

AFTER an expected upturn in 1959, electrical construction, installation and modernization activity should continue upward to gains of about 10% in 1960. Electric work will fare substantially better than construction generally, because the anticipated gains in new construction are in categories involving relatively high electrical budgets. Particularly strong improvements are expected in industrial, commercial and institutional building which involve the large percentage of electrical work in total cost.

New construction expenditures are expected to reach a record-breaking total of $55.3 billion in 1960, an increase of about $1.3 billion, or 2%, over 1959, according to the Business and Defense Services Administration, U. S. Department of Commerce. In 1959, the value of work put in place will probably reach $54 billion, the first time it has ever exceeded the $50 billion mark.

In 1960, both private and public construction should maintain about the same relative importance, increasing 3% and 2% respectively. Because of rising construction costs, the total dollar outlays will represent about the same physical volume (expenditures adjusted for price changes) of work as in 1959.

With construction at this level, the demand for building materials and equipment should be sustained

and the overall impact of construction on employment remains unchanged. Therefore, new construction in 1960 should act as a stabilizing force, but not contribute to the overall economic expansion as it did in 1959.

The anticipated $1.3 billion rise in construction outlays in 1960 represents the net effect of some key changes in recent trends. Especially significant are the downward movements of residential building (private and public) and highways, and the anticipated increase in private nonresidential building activity. The expected gains and losses for most categories of construction represent sharp reversals of the 1958-1959 movements, or attenuations of strong tendencies currently displayed.

The 1960 estimates reflect the expectation that any losses in construction activity in 1959 due to shortages of steel will be made up during the new year. Assuming no further tie-ups, it is expected that, though some lags in deliveries of this key material may occur early in 1960, the total supply will be adequate for the anticipated levels of construction.

The outlook further assumes that the national economy will move forward with gains approaching those in 1959. In addition, the estimates assume a continuation of the rise in construction costs which occurred during 1959, and an adequate supply of basic materials, equipment, and labor. Despite the possibility that money rates will remain high throughout 1960, it appears that investment funds will be adequate to support the dollar volume foreseen for both private and public construction.

Private Construction

The $37.8 billion total for private outlays in 1959—including more than $22 billion for housing, a record level—should rise in 1960 by $1 billion despite an equivalent drop in value put in place for new dwelling units. Thus, private construction, influenced in the current year mainly by the sharp resurgence of residential building, will not be so aided in 1960. Its major source of strength will be nonresidential building.

Private nonfarm housing starts in 1960 will probably number 1,200,000 units—125,000 under 1959. Multiple dwelling units will probably constitute a larger proportion of this total. Dollar outlays will continue to be influenced by the trend to larger, better-quality homes, and by higher costs. However, the decline in dollars will not be in proportion to the drop in housing starts.

In the early part of 1960, new housing starts may begin at a lower rate than is indicated by the annual total now estimated. This will be due largely to the tight supply of mortgage funds as 1959 closes. However, some of the factors which combined strongly this year to push up interest rates and drain off investment funds may be less in evidence as 1960 progresses. For example, pressures in the money market caused by need for Federal financing should ease and inventory accumulation by industry during the last half of 1960 may be less of a factor. It should also be noted that a tendency toward conventional mortgage financing on easier terms makes possible a somewhat lesser reliance on FHA-VA financing during a period when interest rates are as high as they are now.

Funds will be adequate not only for the expected level of housing starts but also to underwrite residential additions and alterations and nonhousekeeping projects. In the latter category, the impact of accelerated motel building, college dormitory expansion programs, and the building of large hotels calls for an increase of almost $150 million in 1960 over 1959—a 20% gain.

The effect of a big carry-over of construction activity for certain types of structures from one year to the next is especially indicated by the influence of nonresidential buildings expenditures on total private expenditures in 1960. The anticipated rise for all private types, from $37.8 to $38.8 billion, in the face of a $650 million drop in housing volume and a $200 million drop in farm volume, is mainly due to a $1.6 billion rise in nonresidential building caused in part by carry-over of work begun in 1959.

Industrial construction, after reaching a peak of almost $3.6 billion in 1957, reacted to the economic downturn in 1958 by a sharp drop of almost one-third and should reach a low point in 1959 at slightly below $2 billion. The 1960 gain of about $500 million, representing a rise of more than one-quarter over 1959, would return industrial outlays to only $2,450 million. Present industrial building programs are probably less influenced by the need for greater capacity than by the need for meeting competition with more efficient production facilities designed to achieve lower unit costs. The growing requirements for research and development are also a factor.

Commercial construction in 1960 will likely record even greater gains than in 1959. Office buildings and warehouses will reverse the 1959 downtrend, because many large office building projects under way in 1959 will contribute heavily to activity in the next 12 months. This category has included a great many large projects in recent years. Office buildings, plus stores, restaurants and garages promise to account for the same value of expenditures in both 1959 and 1960.

Strength in these categories arises from the continued trend towards suburbanization throughout the United States, the need for parking facilities in central city areas, and from the high level of disposable personal income which continues to spark new peaks in the volume of retail business. New shopping center construction should continue its strong pace but lag behind the recent high level of residential activity in outlying areas. However, for the first time, stores, restaurants and garages will likely account for outlays of over $2 billion—double the annual rate of only seven years ago.

Other types of private building are due to be very strong in 1960. Construction of religious buildings should exceed the billion dollar mark. After being interrupted in 1959 by the economic slowdown of 1958, private school building will continue its regular uptrend of recent years. Federal aid will be an important factor in the stimulation of private hospital construction. Social and recreational building activity in 1960 is expected to rise substantially under the influence of high incomes, and the effect of leisure time on national spending habits.

Farm construction expenditures, which tend to follow closely changes in farm income, are expected to decline substantially, following the 1959 downward movement of agricultural income.

Public utilities construction, stable in 1958 and 1959, will likely register a small increase. Uneven movements, however, characterize

the various utility categories. The electric light and power industry has just completed a major program of expansion that has increased its power producing capacity to a point considered generally adequate for today's high-level economy. Gas facilities construction was set off course in 1958 from its long-range growth pattern by legal uncertainties. The problems were resolved because of a recent court decision, and construction resumed its upward swing in 1959. It should reach a new peak in 1960. New pipelines for the transmission of natural gas will contribute heavily to the accelerated activity. Telephone construction expenditures will rise to the volume recorded several years ago before expansion programs were slowed.

Public Construction

Total public construction in 1960 is estimated at $16.5 billion, compared with $16.2 billion in 1959. The small overall gain stems from substantial increases for some categories being offset by decreases in others. The relatively tight money market prevailing and the barrier of legal debt limits will force many states and local communities to somewhat more conservative policies than they followed in recent years. The pressure of unmet public works needs and the existence of Federal aid programs, however, tend to sustain outlays in this area. Direct Federal construction spending for military, atomic energy, conservation and development, and other facilities are not expected to change materially.

Public housing expenditures are also expected to decline in 1960 from the peak of $1 billion in 1959. Public housing starts are estimated at 35,000 in 1960, compared with 40,000 in 1959. Of significance in 1960 is the reduction in the number of units to be started under the military (Capehart) housing program. Starts under other public housing programs should number 25 or 30 thousand, slightly more than in the last two years.

The physical volume of public educational construction in 1960 is expected to stay at about the same level as in 1959, cost increases negating the small dollar gain. Although many new bond issues have been authorized for education construction, an unfavorable money market continues to retard the translation of these authorizations into funds for new schools.

The military construction category will likely be down to some extent in 1960 but will still be strongly influenced by missile programs.

Hospital construction will benefit from Federal aid and should show a small rise in 1960.

Modernization

Modernization of existing electrical systems is expected to climb still higher under the pressure provided by neighboring new construction and demands for modern electrical facilities.

New loads requirements from higher lighting standards and air conditioning will also tend to increase the total value of electrical installation. Increased encouragement of electric space heating by utilities through promotion and attractive rates is opening up an entirely new market for electrical work.

NEW CONSTRUCTION PUT IN PLACE IN THE UNITED STATES (EXCLUDING ALASKA AND HAWAII) 1959 AND OUTLOOK FOR 1960

Type of construction	Value (in millions)		Percent change
	1959[1]	1960[2]	1959-60
Total new construction	**$54,000**	**$55,300**	**+2**
Private construction	**37,800**	**38,800**	**+3**
Residential buildings (nonfarm)	22,150	21,500	−3
New dwelling units	17,000	16,000	−6
Additions and alterations	4,400	4,600	+5
Nonhousekeeping	750	900	+20
Nonresidential buildings (nonfarm)	8,600	10,200	+19
Industrial	1,950	2,450	+26
Commercial	3,850	4,450	+16
Office buildings and warehouses	1,925	2,225	+16
Stores, restaurants and garages	1,925	2,225	+16
Other nonresidential buildings	2,800	3,300	+18
Religious	925	1,050	+14
Educational	530	600	+13
Hospital and institutional	570	700	+23
Social and recreational	540	700	+30
Miscellaneous	235	250	+6
Farm construction	1,750	1,550	−11
Public utilities	5,100	5,350	+5
Railroad	275	250	−9
Telephone and telegraph	900	1,100	+22
Electric light and power	2,075	2,050	−1
Gas	1,700	1,825	+7
Other public utilities	150	125	−17
All other private	200	200	0
Public construction	**16,200**	**16,500**	**+2**
Residential buildings	1,000	900	−10
Nonresidential buildings	4,500	4,725	+5
Industrial	340	375	+10
Educational	2,675	2,750	+3
Hospital and institutional	425	450	+6
Administrative and service	590	700	+19
Other nonresidential buildings	470	450	−4
Military facilities	1,490	1,375	−3
Highways	5,800	5,700	−2
Sewer and water systems	1,465	1,625	+11
Sewer	900	1,000	+11
Water	565	625	+11
Public service enterprises	560	700	+25
Conservation and development	1,150	1,225	+7
All other public	235	250	+6

1. Bureau of the Census statistis. Estimates for last 2 months prepared by BDSA.
2. Estimates prepared by BDSA.

TABLE I — Typical Incandescent Lamps

Rated Life, Efficiency, and Energy Consumption for Equal Light Output

Lamp Description	Rated Life	Initial Lumens Per Watt	Kwhr per Million Lumen Hours
Photoflash No. M5	.030 sec.	....	..
Photoflood No. 1 (250w)	3 hr.	34.0	29
Studio lamp (Ph/250A23) (250w)	20 hr.	26.0	38
Spotlight (G30/SP) (250w)	200 hr.	17.2	58
100-watt A21/IF standard	750 hr.	16.1*	62
100-watt A21/SB Silver Bowl	1000 hr.	14.2	70
100-watt A21/IF ES-120v	2500 hr.	13.1*	76
100-watt A21/IF ES-130v	5000 hr.	11.6	86
100-watt A21/IF long life	10000 hr.	10.4*	96

Data on "rated life" and "initial lumens per watt" taken from lamp manufacturers' published information, except for values with asterik (*), which are from ETL test data used in this report. "Kwhr per Million Lumen-Hours" is calculated.

ENERGY represents a major item in the cost of light, and is measured in kilowatt-hour (kwhr) consumption. Energy costs are determined by "cents/kwhr" energy rates. Unit cost of light for energy only is therefore influenced by two variables: 1) lamp efficiency—lumens per watt; and 2) energy rates—cents per kilowatt-hour. Lamp efficiency determines energy consumption per unit of light, or "Kwhr/Million Lumen-Hours".

The Truth About Long-Life Lamps

A factual analysis of the performance and relative operating costs of "standard," "extended-service," and "long-life" incandescent lamps. Essential data are derived from independent laboratory tests of samples of typical lamps, purchased from typical suppliers.

By Berlon C. Cooper

TABLE II — How Lamps Were Selected for Testing

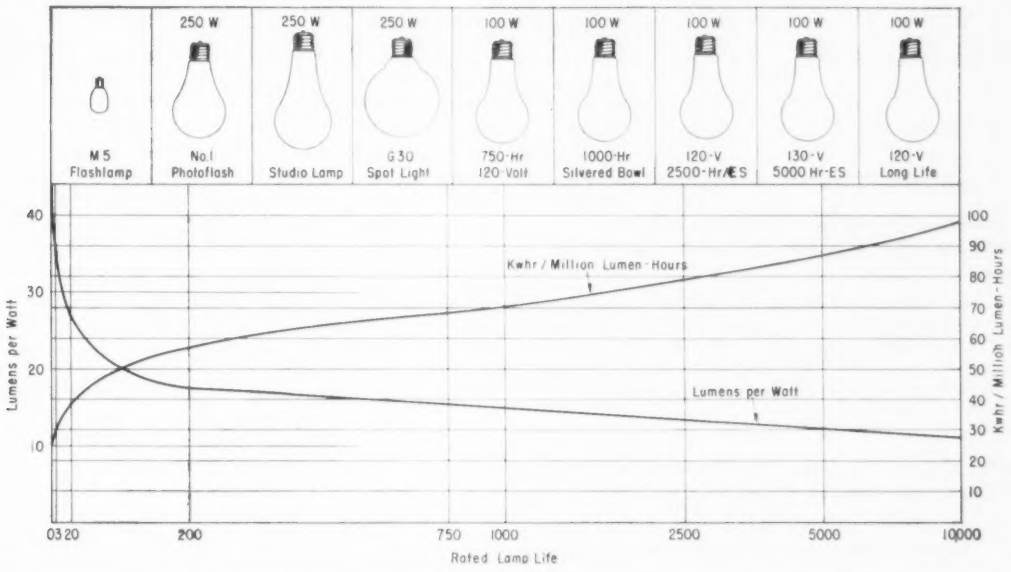
Lamps of different brands, all rated 100 watts, were purchased over the counter out of shelf stock from four retail and wholesale stores, to provide 12 lamps of each of three types, 36 lamps total. The mix of lamp brands is indicated below.

Type Lamp	Rated Life (Hours)	Lamp Brand*	No. of Lamps Each Brand	No. Lamps Tested
A	750**	Brands A, B, C	4	12
B	2500	Brands A, B, C, D	3	12
C	10000	Brands E, F, G	4	12

* Manufacturers whose lamps were tested include: Duro Test, Eternalite, Ever-Glo, General Electric, Marvelite, Sylvania, and Westinghouse.

** All lamps tested were of the A21 inside frost type. The 750-hour rated life lamps were of the gas-filled type, with standard coiled-coil (CC-6) filament.
Lamps were tested by Electrical Testing Laboratories, Inc., New York City.

Means: Lower Efficiency . . . Higher Power Costs . . . For Equal Light Output



THE availability, in retail stores, of incandescent lamps for which 10,000 hours of burning life is claimed, has aroused wide public interest. These "long-life" lamps are listed as available in sizes ranging from 15 to 150 watts.

When first announced some three or four years ago, retail prices ranged on a graduated scale, from 89 cents for the 15-watt size, to $1.42 for the 150-watt size. Currently, retail prices are lower. Typical prices today are: 69 cents for all sizes from 15 watts to, and including, 100 watts, and 99 cents for the 150-watt size. Standard domestic lamp bulbs currently retail at 25 cents each for 25, 40, 50, 60, 75 and 100-watt sizes, and at 33 cents each for the 150-watt size.

While the long-life lamps are premium-priced, compared with standard lamps, economies in lamp bulb costs are still indicated, since a 10,000-hour life lamp will operate as long as thirteen 750-hour lamps. Furthermore, the average housewife, or homeowner, sees an opportunity to eliminate the nuisance problem of replacing burned-out lamps every few months. As a result, long-life lamps are often purchased without any thought being given to the overall economies in lighting which are involved.

Some lamp manufacturers catalog many "special service," or "extended service" lamps, for special lighting applications where longer lamp life is needed for overall economic operation. These lamps are specifically designed to give longer lamp life, usually 2500 hours burning, and good lighting efficiency. However, these special and extended-service lamps are not usually stocked by retailers serving the general public. American incandescent lamp developments tend to concentrate on brighter, whiter and more efficient lamps, with an average life span of 750 or 1000 hours. The public, innocent of technical

TABLE III — Retail Prices of 100-Watt Lamps Tested

Type Lamp	Rated Life (Hours)	Retail Price* (cents)
A	750	25
B	2500	39
C	10000	69**

These retail prices were used in all calculations made in this analysis.

* Includes Federal Excise Tax levied on electric light bulbs and tubes, but does not include any state or local taxes, which may apply at the local level.

** Retail prices of 10,000-hr long life lamps vary, but 69 cents is most prevalent. Prices for the 100-watt size range from 3 for $2.00 and 69 cents each, to $1.05 each, as advertised by various retailers.

TABLE IV — Test Data on 100-Watt Lamps

(As Determined by Electrical Testing Laboratories, Inc.)

Lamp Type	Rated Life (Hours)	Amperes	Watts	Lumens	Lumens Per Watt
A	750	.829	99.5	1602	16.09
B	2,500	.839	100.7	1343	13.08
C	10,000	.893	107.2	1111	10.42

The above data, on each type lamp, are the average values for the 12 lamps of each type as reported by ETL. These data are used for all calculations used in this report involving these types of lamps.

All lamps tested, with one brand exception, were rated "100 watts, 120 volts". On the one brand exception, the four lamps were rated "100 watts, 115–125 volts".

All lamps were laboratory tested at 120 volts.

Before test measurements were made, all lamps were seasoned according to the ETL adopted schedule for these types of lamps.

TABLE V — Energy Cost During Life of Lamps

		Type of Lamp A	B	C
Rated lamp life (hours)		750	2,500	10,000
Total power consumed (Kwhr)*		74.625	251.750	1,072.000
Cost of energy per kwhr (cents)				
Cost of total energy consumed (dollars)	1	.75	2.52	10.72
	2	1.49	5.04	21.44
	2.5**	1.85	6.30	26.80
	3	2.24	7.56	32.16
	4	2.98	10.08	42.88
	5	3.73	12.59	53.60

* Based on actual wattage for each type lamp, as shown by test.

** 1959 national average kwhr-rate in residential use—2.50 cents/kwhr.

Source: Electrical World.

INFLUENCE of the cost of electrical energy on the cost of light is shown above. A 750-hour life lamp, which costs 25 cents at retail, consumes $0.75 worth of energy at a 1¢/kwhr power rate during its rated life, $3.73 worth of energy at a 5¢/kwhr power rate. By comparison, a 10,000-hour life lamp costs 69 cents at retail, and consumes $10.72 worth of energy at 1¢/kwhr during its rated life, or $53.60 worth of energy at a 5¢/kwhr power rate.

Comparative Operating Costs for Three 100-Watt Lamps Having Different Rated Life Values

(Based on 1000 Hours of Use)

TABLE VI — Light Output and Cost of Lamps and Energy

	Type of Lamps A	B	C
Average rated lamp life (hours)	750	2,500	10,000
Light output* lumens/(1000 hours)	1,602,000	1,343,000	1,111,000
Initial cost of lamps (cents)	25	39	69
Number of lamps used/1000 hours	1.335	.400	.100
Lamp cost/1000 hours (cents)	33.4	15.6	6.9
Energy consumed (kwhr/1000 hours)	99.5	100.7	107.2
Cost of energy/1000 hours (2.5¢/kwhr) (dollars)	2.49	2.52	2.68
Cost of lamps and energy/1000 hours (dollars)	2.83	2.68	2.75

* All calculations based on initial lumens (see table IV).

TABLE VII — Cost of Lamps, Energy and Relamping Labor For Equal Light Output

Related to Light Output of 10,000-Hour Life Lamp

	Type of Lamps A	B	C
Relative light output* (C lamp = 1.000)	1.441	1.200	1.000
Adjusted number of lamps	.927	.334	.100
Cost of lamps (cents)	23	13	7
Energy consumed (kwhr)	68.3	84	107.2
Cost of energy (2.5¢/kwhr) (dollars)	1.71	2.10	2.68
Cost of lamps and energy (dollars)	1.94	2.23	2.75
Cost of relamping labor (@ 50¢/lamp) (cents)	46	17	7
Total cost (lamp, energy, relamping labor) (dollars)	2.40	2.40	2.82

* All calculations based on initial lumens (see Table IV).

TABLE VIII — Cost of Lamps, Energy and Relamping Labor For Equal Light Output

Related to Light Output of 750-Hour Life Lamp

	Type of Lamps A	B	C
Relative light output* (A lamp = 1.000)	1.000	.839	.694
Adjusted number of lamps	1.335	.478	.144
Cost of lamps (cents)	34	19	10
Energy consumed (kwhr)	99.5	120.1	154.6
Cost of energy (2.5¢/kwhr) (dollars)	2.49	3.01	3.87
Cost of lamps and energy (dollars)	2.83	3.20	3.97
Cost of relamping labor (50¢/lamp) (cents)	67	20	7
Total cost (lamp, energy, relamping labor) (dollars)	3.50	3.44	4.04

* All calculations based on initial lumens (see Table IV).

knowledge of lamp design and performance, is understandably confused.

Part of this confusion undoubtedly lies in the industry practice of describing lamps in terms of "watts." Reference to manufacturers' data will show that the light output, or "lumens per watt," from a "100-watt" lamp varies over a wide range, depending upon the service and life for which it is designed (see Table I). Standard lamps are an economical compromise to provide white light efficiently for a reasonable average life. The extended life of special lamps of the same wattage is achieved with a necessary sacrifice of whiteness of the light produced and of lumen output, or efficiency. Neither the *wattage* of a light bulb, nor its *rated life* are suitable yardsticks for judging the quantity and quality of the light produced. It is possible to design a lamp for practically any life span, but it is a law of physics that as lamp life is increased, light output is decreased.

The purpose of a light bulb is to produce light efficiently and economically. Therefore, light output, life, and current consumed must all be considered in the design of a lamp, and carefully balanced to provide maximum benefit for the consumer.

Need for Unbiased Report

Recognizing the need for a clarification of this problem, *Electrical Construction and Maintenance* decided to find the facts and report thereon. It was decided that the basic requirement for this project was a set of unbiased data on which to base the study. Technical data on lamps were readily available from all lamp manufacturers. However, it was decided that a more rigorous approach would be to purchase lamps in the open retail market, the

DURING 1000 HOURS of use, the A lamp produces 1,602,000 lumen-hours, at a total cost of $2.83 for lamps and energy. This compares with 1,343,000 lumen-hours of light for the B lamp, at a total cost of $2.68 for lamps and energy, and with 1,111,000 lumen-hours of light for the C lamp, at a total cost of $2.75 for lamps and energy. These data are shown in Table VI (left). When costs are adjusted for equal light output, for economic comparison, and relamping labor costs are added, as shown in Tables VII and VIII, the total costs change as indicated. Energy costs are a major factor in total cost of light, in all cases.

Comparative Operating Costs for Three 100-Watt Lamps Having Different Rated Life Values

(Based on a Million Lumen-Hours of Light)

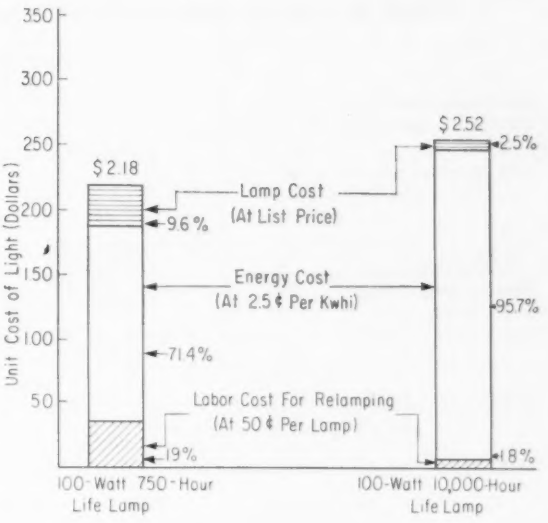
TABLE IX — Total Cost of a Million Lumen-Hours* of Light

(For lamps, energy, and relamping labor)**

	Type of Lamp A	B	C
Rated lamp life (hours)	750	2,500	10,000
Light output per lamp (lumens)	1,602	1,343	1,111
Watts consumed at 120-volts (watts)	99.5	100.7	107.2
Percentage of rated lamp life required per MLH (%)	83.2	29.9	9.0
Lamp cost per MLH (cents)	20.8	11.6	6.2
Energy consumed per MLH (kwhr)	62.5	75.0	119.4
Energy cost per MLH (dollars)	1.55	1.88	2.41
Labor cost for relamping (cents)	4.17	14.9	4.5
Total lamp, energy and relamping labor cost per MLH (dollars)	2.18	2.15	2.52
Lamp cost as percent of total cost (%)	9.6	5.4	2.5
Energy cost as percent of total cost (%)	71.4	87.6	95.7
Relamping labor cost as percent of total cost (%)	19.0	7.0	1.8

* Million Lumen-Hours (MLH) is a convenient "unit quantity of light", for making economic comparisons in the cost of light.

** Lamps at retail price; energy at 2.5 cents/kwhr; relamping labor at 50 cents per lamp.



COST OF LAMPS and of relamping labor are a higher percentage of total cost of light for standard (750-hour life) lamps than that for long-life (10,000-hour life) lamps, but total cost of light, under average conditions, are lower for the standard lamps.

Cost of Lamps Decrease as Rated Lamp Life Increases For a Unit Quantity of Light

TABLE X — Cost of Lamps per Million Lumen-Hours

(Based on Retail Price and at Varying Discounts)

			Type of Lamp A	B	C
Rated lamp life (hours)			750	2,500	10,000
Lamps used to produce a Million Lumen-Hours			.832	.299	.09
			Lamp Cost per MLH (cents)		
Cost of lamps at Varying Discounts		(cents)			
A-Lamp	retail price	25.0	20.8		
	10% discount	22.5	18.7		
	25% discount	18.7	15.6		
	40% discount	15.0	12.5		
B-lamp	retail price	39.0		11.7	
	10% discount	35.2		10.5	
	25% discount	29.2		8.7	
	40% discount	23.3		7.0	
C-lamp	retail price	69.0			6.2
	10% discount	62.2			5.6
	25% discount	51.8			4.7
	40% discount	41.4			3.7

LAMP COSTS average about 10% of total cost of light when using standard 750-hour and 1000-hour life lamps, and less for longer-life lamps. Lamp discounts therefore influence total cost of light very little.

same as any consumer, and have them tested by a laboratory. That is the procedure that was followed.

The 100-watt inside frost type lamp is the most popularly used lamp in the home today. It was therefore decided to base this study on 100-watt lamps only. Findings based on the 100-watt size lamp can be applied generally to other sizes of lamps. It was further decided to limit this study to three basic life ratings—750-hour standard lamps, 2,500-hour extended-service lamps, and 10,000-hour long-life lamps. All lamps purchased were rated "100 watts, 120 volts," except for those of one manufacturer, whose lamps were rated "100 watts, 115-125 volts."

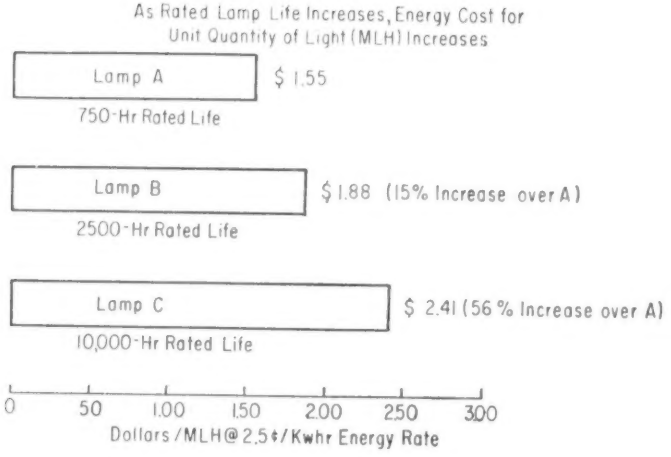
All lamps were tested by Electrical Testing Laboratories, Inc. Before test measurements were begun, each lamp was individually labeled, and all lamps seasoned according to ETL adopted schedule for testing these types of lamps. All lamps were then laboratory tested for amperes, watts, lumens, and lumens per watt, at 120 volts. The test data for all lamps of each "rated life" type were then averaged. These data, shown in Table IV, form the basis for this report.

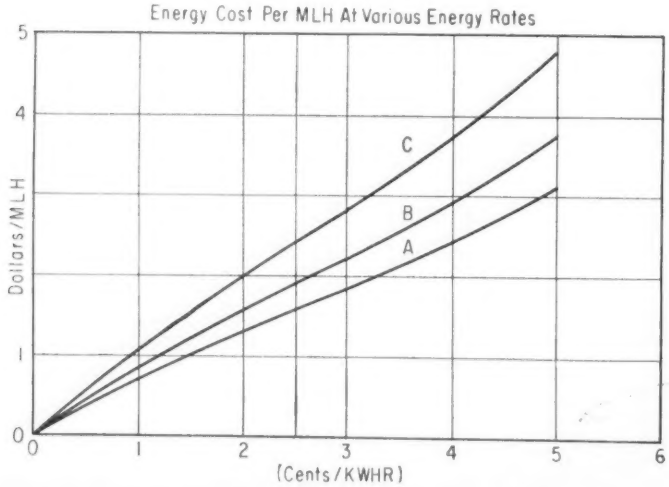
It is relevant to point out, however, that the technical data obtained through this completely independent procedure are not significantly different from that which are published and readily available from any of the manufacturers of the types of lamps involved.

Cost of Energy Increases as Rated Lamp Life Increases For a Unit Quantity of Light

TABLE XI — Energy Cost per Million Lumen-Hours

		Type of Lamp A	B	C
Rated lamp life (hours)		750	2,500	10,000
Total light output during rated life (lumen-hours)		1,201,500	3,357,500	11,110,000
Cost of energy per kwhr (cents)				
Cost of Energy per Million Lumen-Hours (Dollars)	1	.62	.75	.97
	2	1.24	1.50	1.93
	2.5	1.55	1.88	2.41
	3	1.86	2.25	2.90
	4	2.48	3.00	3.86
	5	3.10	3.75	4.85





ENERGY RATES greatly influence total lighting costs, as total cost of energy varies directly with the energy rate, or "cents per kwhr".

Analysis of Test Data

Presented herein are a series of tables and charts, each of which has been developed to present and to clarify one or more of the factors involved in making an economic analysis of the cost of light. The calculations in each table relating to the types of lamps tested—750-hour (Type A), 2,500-hour (Type B), and 10,000-hour (Type C)—are all based on the technical data which resulted from the independent test. Tables II, III, and IV show these data.

The data shown in Table I, based on manufacturers' published data, illustrate a basic characteristic of filament lamps, which is that as rated life increases, lamp efficiency, measured in "lumens per watt," decreases. This characteristic has been further translated into "Kwhr per Million Lumen-Hours," or energy consumed per a unit quantity of light.

Conventional lamp bulbs are purchased and used by consumer for one reason—to produce light. The cost of light so produced is affected by three factors: 1) cost of the lamp bulbs; 2) cost of the energy consumed; and 3) cost of the labor involved in replacing the lamps. Each factor may vary over a considerable range, from one customer to another, from one community to another, and depending upon whether consumers replace lamps on a "do-it-yourself" basis, or pay for having it done. Tables in

LAMP COSTS as a percentage of total cost per MLH of light shown in Table XIII (page opposite) are based on total cost per MLH at an energy rate of 2.5 cents per kwhr. When energy rates are lower, the lamp cost percentage will be higher; and conversely, when energy rates are higher, the lamp cost percentage will be lower.

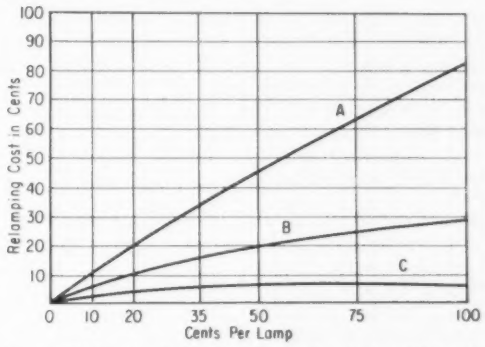
ENERGY COSTS at all generally available rates are uniformly high as a percentage of total cost of light, for longer life lamps, as shown for B and C lamps in Table XIV. Conversely, this indicates that lamp costs and relamping labor costs represent a higher percentage of total cost of light for standard (A type) lamps.

LONGER LIFE lamps become more economical in the production of light as the labor cost per lamp for relamping increases. Total cost of light per MLH in table above is based on an energy rate of 2.5¢/kwhr, and lamp cost at retail prices. For more accurate appraisal for a specific installation, actual energy cost rate and lamp costs which will apply should be used.

Cost of Labor for Relamping Decreases as Rated Lamp Life Increases For a Unit Quantity of Light

TABLE XII — Labor Cost for Relamping per Million Lumen-Hours

		Type of Lamp A	B	C
Rated lamp life (hours)		750	2500	10,000
Lamps used to produce a Million Lumen-Hours		.832	.299	.09
Labor cost for replacing one lamp (cents)				
Relamping Cost per Million Lumen-Hours (dollars)	10	.08	.03	.009
	20	.17	.06	.018
	35	.29	.11	.031
	50	.42	.15	.045
	75	.63	.23	.068
	100	.83	.30	.09



HIGH COST per lamp for relamping can be offset in part by using longer life lamps. Another method of reducing total relamping labor cost is to use "group relamping" to reduce the labor cost per lamp.

Relative Cost of Lamps In Producing a Million Lumen-Hours of Light

TABLE XIII — Lamp Cost Versus Total Cost* of Light

(Based on Cost of Lamps at Retail Price, and at 40% Discount)

	Type of Lamp A		B		C	
Rated lamp life hrs.	750		2500		10,000	
Energy* cost per MLH (dollars)	1.55		1.88		2.41	
Relamping labor cost** per MLH (cents)	41.7		14.9		4.5	
Lamps purchased at	Retail	40%	Retail	40%	Retail	40%
Lamp cost per MLH (cents)	20.8	12.5	11.7	7.0	6.2	3.7
Total cost per MLH (dollars)	2.18	2.09	2.15	2.10	2.52	2.49
Ratio of lamp cost to total cost per MLH (%)	9.55	6.00	5.45	3.33	2.46	1.48

*Energy cost at 2.5¢/kwhr. **Labor cost for relamping at 50¢ per lamp.

Relative Cost of Energy In Producing a Million Lumen-Hours of Light

TABLE XIV — Energy Cost Versus Total Cost* of Light

(Based on Varying Rates per Kwhr)

		Type of Lamp A		B		C	
Rates lamp life (hours)		750		2,500		10,000	
Kwhr required/MLH		62.09		75.02		96.48	
Cents/kwhr rate for energy		$/MLH	%	$/MLH	%	$/MLH	%
Energy Cost/MLH and % of Total Cost* of Light	1	.62	50.0	.75	74.0	.97	92.0
	2	1.24	66.5	1.50	85.0	1.93	96.0
	2.5	1.55	71.1	1.88	87.4	2.41	96.8
	3	1.86	75.1	2.25	89.5	2.90	97.4
	4	2.48	79.7	3.00	91.8	3.86	98.0
	5	3.10	83.2	3.75	93.5	4.85	98.4

* Lamp cost at list price; and relamping labor cost at 50¢ per lamp: A—62.5¢; B—26.6¢; C—8.0¢. For total cost of light (MLH), add energy cost as shown.

Relative Cost of Labor for Relamping In Producing a Million Lumen-Hours of Light

TABLE XV — Relamping Labor Cost Versus Total Cost* of Light

(Based on a Range of Labor Costs per Lamp)

Type Lamp	Rated Lamp Life (Hours)	Energy Cost per MLH (dollars)	Lamp Cost** per MLH (cents)	Labor Cost per Lamp for Relamping (cents)	Labor Cost for Relamping per MLH (cents)	Total Cost per MLH (dollars)	Ratio of Relamping Labor Cost to Total Cost (%)
A	750	1.55	20.8	0	0	1.76	0
				25	20.8	1.97	10.5
				50	41.7	2.18	19.0
				75	62.4	2.38	26.1
				100	83.2	2.59	32.2
B	2500	1.88	11.6	0	0	2.00	0
				25	7.5	2.07	3.6
				50	14.9	2.15	6.9
				75	22.4	2.22	10.1
				100	30.0	2.30	13.0
C	10,000	2.41	6.2	0	0	2.47	0
				25	2.3	2.49	0.9
				50	4.5	2.52	1.8
				75	6.7	2.54	2.6
				100	9.0	2.56	3.5

* Energy cost at 2.5¢/kwhr.
** Lamp cost at retail price: A—25¢; B—39¢; C—69¢.

TABLE XVI — Comparisons of Total Cost of Light*

A — When Energy Rate is High, Relamping Labor Cost is Low

	Type of Lamp		
	A	B	C
Rated lamp life (hours)	750	2500	10,000
Energy cost, at 5¢/kwhr (dollars)	3.10	3.75	4.85
Lamp cost, at list price (cents)	.21	.12	.06
Relamping labor cost, at 25¢/lamp (cents)	.21	.08	.02
Total cost of light (MLH) (dollars)	3.52	3.95	4.93
Ratio: Lamp A to lamp B (%)	89.0 (B)		
Ratio: lamp A to lamp C (%)	71.4 (C)		
Ratio: lamp B to lamp A (%)		112.2 (A)	
Ratio: lamp B to lamp C (%)		80.2 (C)	
Ratio: lamp C to lamp A (%)			140.1 (A)
Ratio: lamp C to lamp B (%)			125.0 (B)

* Based on Million Lumen-Hours of Light (MLH), with energy rate of 5¢/kwhr, lamps at list price, and relamping labor cost of 25¢ per lamp.

B — When Energy Rate is Low, Relamping Cost is High, and Lamps are Purchased at 40% Discount

	Type of Lamp		
	A	B	C
Rated lamp life (hours)	750	2,500	10,000
Energy cost, at 1¢/kwhr (dollars)	.62	.75	.90
Lamp cost, at 40% discount (cents)	12.5	7.0	3.7
Relamping labor cost, at $1.00/lamp (cents)	.832	.300	.090
Total cost of light (MLH) (dollars)	1.58	1.12	1.03
Ratio: lamp A to lamp B (%)	141 (B)		
Ratio: lamp A to lamp C (%)	153 (C)		
Ratio: lamp B to lamp A (%)		71 (A)	
Ratio: lamp B to lamp C (%)		107 (C)	
Ratio: lamp C to lamp A (%)			65 (A)
Ratio: lamp C to lamp B (%)			92 (B)

* Based on Million Lumen-Hours of light (MLH), with energy rate of 1¢/kwhr, 40% discount on lamps, and relamping labor cost of $1.00/lamp.

C — In a Typical Residence

(Based on energy rate of 3¢/kwhr, lamps at list price, and no cost for replacing lamps)

	Type of Lamp		
	A	B	C
Rated lamp life (hours)	750	2,500	10,000
Energy cost, at 3¢/kwhr (dollars)	1.86	2.25	2.90
Lamp cost, at list price (cents)	21	12	6
Total cost of light (MLH) (dollars)	2.07	2.37	2.96
Ratio: lamp A to lamp B (%)	87.4 (B)		
Ratio: lamp A to lamp C (%)	70.0 (C)		
Ratio: lamp B to lamp A (%)		114.4 (A)	
Ratio: lamp B to lamp C (%)		80.0 (C)	
Ratio: lamp C to lamp A (%)			143.0 (A)
Ratio: lamp C to lamp B (%)			125.0 (B)

* Based on unit quantity of a Million Lumen-Hours of light.

UNIT COSTS of light for most lighting applications in general use will range between the extremes indicated in Tables XVI-A and XVI-B. Conditions and cost outlined in Table XVI-A might apply in small commercial establishments where the owner replaces the lamp bulbs. Conditions and costs outlined in Table XVI-B would be generally applicable for a large industrial plant enjoying a low energy rate and paying a high wage rate for maintenance labor. Conditions assumed in Table XVI-C for a typical residence are considered as generally applicable for the average homeowner.

this report deal basically with these variables, and are designed to show the relative influence of each on the total cost of light, and the relative influence of each factor over its range of variations.

All calculations in this report have been based on "initial lumens" and "initial lumens per watt." In actual practice, calculations are normally based on average, or "mean lumens per watt" throughout the life of the lamp. It was impractical to conduct complete life tests on the set of test lamps, as this would have involved a very long period of testing. Sample calculations covering lamps of varying rated life, using both initial lumen values and mean lumen values as listed by manufacturers, show no significant variations between the final results. Therefore it was decided that the use of "initial lumens per watt" was practical for purposes of comparison of lamps in this report.

When a homeowner purchases a lamp over-the-counter, he understands the "retail price" of the lamp. But does he understand also that the purchase of the lamp also represents a potential investment in electrical energy of many times the retail price of the lamp, depending upon the "life rating" of the lamp bulb, and upon the "cents per kwhr" rate at which he pays for his electrical energy? These relationships are shown in Table V.

Table V makes no allowances for the fact that each lamp lasts for a different length of time, nor for the fact that each lamp produces a different quantity of light. These variations are considered in subsequent tables.

Comparative Costs for 1000 Hours of Use

The average lamp bulb consumer also understands the use of a 100-watt lamp for 1000 hours. So tables VI, VII and VIII were developed to show comparative operating costs on each of the three types of lamps over a period of 1000 hours. Table VI shows total cost for lamps and energy, but does not take into account the variations in light output of the different lamps.

Thus, in table VII, the data are adjusted to show the cost of lamps and energy to produce the same quantity of light as that produced by the 10,000-hour rated life lamp. The item of cost of relamping labor is also added. Table VIII is similar to Table VII, except that the data

You May Also Use . . . 125-Volt and 130-Volt Rated Lamps On Standard 120-Volt Circuits . . . to Extend Lamp Life

TABLE XVII — Effect of Voltage Rating on Incandescent Lamps When Operated on Different Circuit Voltages

	Operated at Voltages Above		Below	
When circuit voltage is above or below rated voltage by (%)	10	5	5	10
Lamp lumens change to (% of normal)	130	112	88	78
Lamp life changes to (% of normal)	38	58	180	310

MAXIMUM LIGHT output at minimum overall unit cost of light generally results when lamps are operated at their rated voltage. It is true, however, that lamp life increases when lamps are operated under the voltages for which they are designed. It is also true that light output decreases under these same conditions, and it may be necessary to use the next size larger lamp (e.g., 150-watt lamps in place of 100-watt lamps) when this is done. This automatically increases the wattage consumed, for the same unit light output, and energy cost is a major part of the unit cost of light, as data in accompanying tables indicate. Under certain adverse relamping conditions, use of 130-volt lamps on 120-volt circuits may be justified, but this practice should only be adopted after careful analysis and study of the problem, based on actual factors involved.

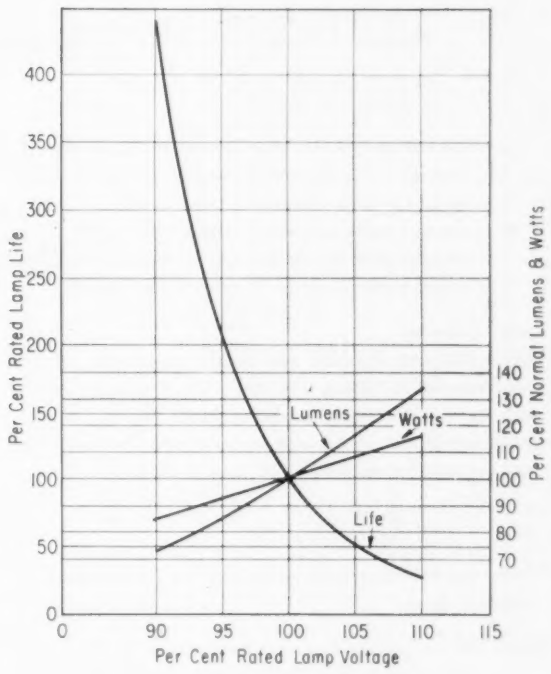


TABLE XVIII — Comparative Data on 100-Watt Standard and Extended Service Lamps

(rated 120 and 130 volts on 120-volt circuits)

	Types of Lamps: Standard		Extended Service	
Rated average life (hours)	750	2,320	2,500	5,000
Rated lamp voltage (volts)	120	130	120	125–130
Rated Lamp wattage (watts)	100	100	100	100
Lamp wattage at 120 volts (watts)	100	82	100	82
Initial lumens* at 120 volts	1630	1268	1370	1164
Relative illumination	1.000	.778	.840	.714
Retail price (cents)	25	25	39	39
Relamping cost (cents)	50	50	50	50
Energy rate (¢/kwhr) (cents)	2.5	2.5	2.5	2.5
Cost per Million Lumen-Hrs. (dollars)	2.14	2.28	2.08	2.33

* All calculations based on initial lumens.

Source: Basic data above taken from Technical Bulletin No. PBR-217, Research Division, Public Buildings Services, General Services Administration, Washington, D.C.

EXTENDED SERVICE and 130-volt standard lamps are now used in Federal buildings under the jurisdiction of the Office of Buildings Management, Public Buildings Services, General Services Administration, Washington, D. C., in sizes from 25 to 150 watts. The 130-volt standard lamps have been approved for use in toilet rooms, stairwells, basements and corridors where relamping is not difficult, but where lamp outage may create an unsatisfactory condition. The entended service 2500-hour life lamps, with a voltage rating of 125-130 volts (which provides 5000 hours of operation on 120-volt circuits) have been approved and are in use in clock towers, outside arcades, and lighting coves in lobbies and high rotundas, where high ladders and special scaffolding are required for relamping. This practice was approved following extensive testing and study of various types of lamps over a period of four to five years.

TABLE XIX —Use These Basic Formulas to Determine . . .

(A) Economics of Light Production With Incandescent Lamps

$$U = \frac{10}{\text{Efficiency}} \left(\frac{\text{Lamp Cost}}{\text{Watts} \times \text{Life}} + \text{Kwhr Cost} \right)$$

or $U = \frac{10}{E} \left(\frac{P}{WL} + R \right)$, where

U = unit cost of light per million lumen-hours (dollars)
E = average lumens per watt throughout life (lumens/watt)
P = net cost of lamp delivered in socket (cents)
W = average watts consumed throughout life (watts)
L = average lamp life, in thousands of hours (hours/1,000)
R = cost of electrical energy in cents per kwhr (cents)

Typical Example:

Assume 100-watt standard incandescent lamp, with average rated lamp life of 750 hours, net cost of 25 cents, consuming 99.5 watts on 120-volt circuit, producing 16.02 lumens per watt, electric energy rate of 2.5 cents per kwhr, and labor cost of 50 cents per lamp for replacing. ("A" lamp in test data.)

$$U = \frac{10}{16.0} \left(\frac{75}{99.5 \times .75} \right) + 2.5 = \$2.18^*$$

* Note that this value is shown in Table IX for the conditions assumed above.

Source: Proceedings of the Illuminating Engineering Society, 1937, page 1077, article by G. S. Merrill, entitled "The Economics of Light Production With Incandescent Lamps".

(B) Most Economical Lamp Replacement Method*

(1) Individual Replacement— $\frac{B}{R}$ (c + i) dollars/socket/year

(2) Group replacement**— $\frac{B}{A}$ (c + g) dollars/socket/year

B = burning hours per year (hours)
R = rated average lamp life (hours)
A = burning time between replacement (hours)
c = net cost of lamps (dollars)
i = cost per lamp for replacing lamps individually (dollars)
g = cost per lamp for replacing lamps in a group (dollars)

* Applies to lamp cost and labor for replacement only.
** No replacement of early burnouts.

Source: IES Lighting Handbook, 3rd edition, Section 8, page 16.

Typical example, using the following assumed conditions:

B = 5 hours burning per day, 365 days a year—1825 hours
R = 750-hour type A21/IF standard lamp—750 hours
A = 600 hours burning time between replacements—600 hours
c = 25 cents cost of lamp, retail price—.25 dollars
i = 50 cents labor cost for individual lamp replacement—.50 dollars
g = 15 cents labor cost for group replacing lamps—.15 dollars

Individual replacement cost = $\frac{1825}{750}$ (.25+.50) = \$1.83/skt/yr.

Group replacement cost — $\frac{1825}{750}$ (.25 + .15) = \$1.22/skt/yr.

CALCULATIONS throughout this report were made on a step-by-step basis. All "unit cost of light per million lumen-hours" values were then checked for accuracy by using the formula shown above. The lamp replacement formulas will be found useful in analyzing all lamp cost and relamping labor cost problems, and studies relating to lamp life.

are adjusted to show the cost of lamps and energy to produce the quantity of light that is produced by the 750-hour rated life lamp.

Comparative Cost for Million Lumen-Hours

Light output from lamps is measured in "lumens" and when lamps are burned over a period of time, the quantity of light produced over that period of time is measured in "lumen-hours." Since this unit of measure is for a relatively small quantity of light, it is more convenient to use a "Million Lumen-Hours," which has been generally adopted as standard practice by the lighting industry. Thus, in order to explore in depth the influence of variations of each of the three factors involved in the "total cost of light" from the three types of lamps tested, data presented in Tables IX to XVI inclusive were developed. Use of the unit quantity of light, a "Million Lumen-Hours," automatically adjusts the data to compensate for the difference in light output between the three types of lamps.

Table IX shows the total cost of a million lumen-hours of light, for lamps, energy and relamping labor, for each of the three types of lamps. The data are based on specific assumptions: 1) lamps at retail price; 2) energy at 2.5 cents per kwhr; and 3) relamping labor at 50 cents per lamp. These represent what may be considered more or less "average" conditions. However, since each of these three factors are variable, Tables X, XI and XII were developed to show the total cost of each factor over a range of variables.

In the above tables, actual dollar values have been used, for total cost of light, and for lamps, energy, and relamping labor cost. When the cost of lamps, energy, and relamping labor are expressed as a percentage of the total cost of light, then relative importance becomes more evident. This has been done in Tables XIII, XIV and XV, for lamps, energy, and relamping labor.

Carrying the analysis one step further, Table XVI shows comparisons of the total cost of light from each of the three types of lamps, at each of two extremes, and for a typical home owner.

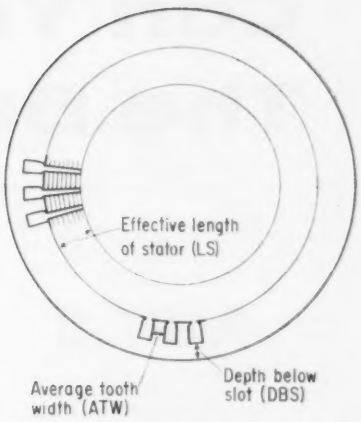
Long Lamp Life With Higher Voltage Lamps

Many commercial and industrial establishments, which have incandescent lamps installed in hard-to-get-at locations, have for years met and solved this problem satisfactorily by using lamps rated at 125 or 130 volts on standard 115 and 120-volt systems. More recently, some lamp manufacturers have made available 2,500-hour rated life lamps, in both 120-volt and 125-130-volt ratings, to meet this same problem. The economies of these two methods are presented in Tables XVII and XVIII.

Finally, the basic formula for determining the unit cost of light under a set of specific conditions is presented in Table XIX-A, and two formulas for determining the cost of lamp replacement, one on an individual replacement basis, and the other on a group replacement basis, are given in Table XIX-B.

Rewinding 3-Phase Squirrel Cage Motors for Speed Changes

By **John Molnar**, *Consulting Engineer, Moorestown, N. J.*



MOTOR CONSTANTS necessary for figuring magnetic circuit areas.

THE primary function of a plant motor rewind shop is to replace a faulty winding with an identical one, i.e., rewind for original characteristics. But there are times when a change becomes necessary and one that is most apt to be fraught with difficulty is where a change in speed is required.

The first step, after the stator has been stripped, is to determine the motor constants. These are built in by the original designer and are (see illustration):

1. Number of slots (S)
2. Lamination depth below slots (DBS)
3. Average tooth width (ATW)
4. Effective length of stator (LS). This is equal to: actual length of stator minus length of ventilating ducts, when used, times 0.93. The figure 0.93 is a stacking factor used because the core is laminated, and it is necessary to make allowances for the thickness of the varnish, etc., between punchings.

The maximum allowable magnetic flux density in the stator is one of the primary limiting factors affecting the horsepower rating of a rewound motor. To figure the magnetic densities, it is necessary to calculate the area of two important regions, i. e., the stator core area and stator tooth area.

Stator Core Area = 2 x LS x DBS

The factor 2 is used because the flux divides in half at the pole centers.

Stator Tooth Area = ATW x LS x S/P

Where P = the new number of poles.

The allowable magnetic density for 60-cycle calculations may be safely assumed as follows:

Stator core density from 70,000 to 100,000 lines per sq in.

Stator tooth density from 85,000 to 115,000 lines per sq in.

A new winding for an old stator core can now be calculated. When a motor is rewound for a higher speed, the stator core density is the limiting factor; therefore, calculate the flux per pole using the following formula:

Flux per pole = stator core density x stator core area.

When a motor is rewound for a lower speed, start with the following:

Flux per pole = stator tooth density x stator tooth area x 0.637.

The factor 0.637 is used in figuring the stator tooth density because the flux density over the pole face is not uniform. In either case, use the formula that yields the higher flux per pole.

The next step is to determine the effective conductor per phase:

$$\text{Effective conductor per phase} = \frac{E \times 45 \times 1{,}000{,}000}{\text{flux per pole} \times \text{cycles}}$$

where E = volts per phase. In star-connected motors E = line voltage $\div \sqrt{3}$ and in delta-connected motors E = line voltage.

From this the actual turns per coil can be determined as follows:

$$\text{Turns per coil} = \frac{\text{effective conductors per phase} \times \text{number of phases} \times \text{no. of parallel circuits}}{\text{distribution factor} \times S \times 2 \times \text{chord factor}}$$

where distribution factor for a 3-phase winding, 3 slots per pole per phase, is equal to 0.960. This value can be safely assumed in all cases.

$$\text{Chord factor} = \sin\left(\frac{\text{coil span}}{\text{slots/pole}} \times 90°\right)$$

i. e., for a coil throw slot 1 to 11, with 12 slots per pole

$$\text{Chord factor} = \sin\left(\frac{10}{12} \times 90°\right) = 0.9659$$

Number of parallel circuits is equal to 2 providing E is calculated from a line voltage of $\frac{220}{\sqrt{3}}$ for a 220/440-volt motor, and is equal to 1 when E is calculated from $\frac{440}{\sqrt{3}}$ for a 440-volt motor.

The new horsepower will vary as the square of the magnetic flux density. Since the physical dimensions of the stator remain constant, the following formula was derived to determine the new horsepower:

$$\text{new hp} = \frac{\text{old hp} \times (\text{new flux per pole} \times \text{new number of poles})^2}{(\text{old flux per pole} \times \text{old number of poles})^2}$$

From this the stator current per phase is—

$$I = \frac{\text{hp} \times 746}{\text{volts per phase} \times 3 \times \text{eff} \times \text{PF}}$$

Finally, the cross section area of the wire to be used is:

$$\text{area} = \frac{I}{\text{parallel paths} \times 3000}$$

(3,000 amps per square inch is the selected current density)

The exact horsepower output of this rewound motor can be determined by test.

The above is not a panacea for all motor rewind problems involving speed changes, but it is a comprehensive outline that provides the necessary fundamentals.

Can You Select The Better Contracts?

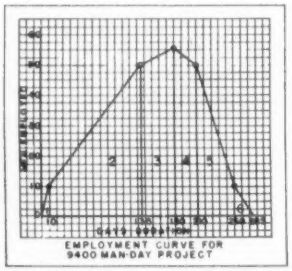
PART II

Only the electrical contractor can determine if a specific job will fit his organizational setup. Careful consideration of these pertinent factors will help you determine what constitutes a desirable contract.

By Ray Ashley
Research and Consulting Engineer, Oak Park, Ill.

CONSTRUCTION PERIODS FOR ECONOMIC OPERATION OF ELECTRICAL INSTALLATIONS — INDUSTRIAL
SEE NOTES BELOW

LABOR		CONSTRN PERIODS-SEE SKETCH BEL.									TOTAL PERIOD		AV.NO. OF MEN EMPL.
		1 & 6			2 & 5			4 & 3					
MAN HOURS	MAN DAYS	DAYS	MEN AV	MAN DAYS	DAYS	MEN AV	MAN DAYS	DAYS	MEN AV.	MAN DAYS	DAYS	WKS.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1,250	156	10	2	20	12	4	48	15	6	90	37	7.4	4.2
3,150	394	12	2	24	35	6	210	16	10	160	63	12.5	6.3
6,400	800	12	2	24	52	8	416	30	12	360	94	19.	8.5
13,600	1700	15	4	60	75	12	900	37	20	740	127	25.4	13.4
28,000	3,500	20	4	80	125	16	2,000	60	24	1,440	205	41	17.1
44,000	5,500	30	5	150	145	22	3,190	60	36	2160	235	47	23.4
59,500	7,440	30	5	150	160	26	4,160	70	45	3,150	265	53	28.5
75,000	9,375	35	5	175	175	30	5,250	75	53	3,975	285	57	33.
90,000	11,250	40	5	200	185	34	6,290	80	60	4,800	305	61	37.
112,500	14,060	42	7	294	225.	37	8,325	85	64	5,440	350	70	40.
150,000	18,750	45	11	495	270	45	12,150	85	72	6,120	400	80	47.
190,000	23,750	50	14	700	295	54	15,930	90	80	7,200	435	87	54.5
230,000	28,750	60	15	900	300	66	19,800	90	90	8,100	450	90	64.
267,000	33,375	65	16	1,040	304	72	21,888	95	110	10,450	465	93	72.
305,000	38,125	70	18	1,260	310	79	24,490	100	125	12,500	480	96	80



ESTIMATED OPTIMUM DURATION FOR A JOB REQUIRING 9400 MAN-DAYS

PERIOD	DAYS	NO. OF MEN-AV	MAN DAYS
1	10	5	50
2	125	30	3750
3	45	53	2385
4	30	53	1590
5	50	30	1500
6	25	5	125
TOTALS	285		9400

1.-PERIODS BASED ON PROGRESS FREE OF INTERFERENCE FROM OTHER OPERATIONS. 2.-CONTRACTOR MUST BE MANNED, EQUIPPED AND ORGANIZED TO EXPEDITIOUSLY CARRY ON THE WORK. 4-24-56

FIG. 1. There is an optimum duration for every contract. This table shows representative construction periods for industrial electrical projects with manpower demands suitable to size and nature of job.

IN Part I of this article (EC&M, December, 1959), two project types were compared to illustrate what may make one job more "desirable" than the other. The fact that the industrial job proved more inviting than the alteration work was not meant to establish any generalities in this respect. Each job must be evaluated individually and the factors weighed against the contractor's organizational setup and work program at that time.

A desirable project is one that, upon completion, will yield a profit in both money and satisfaction. Work suited to one contractor may not be of any value to another. Individual business cycles change and work that would be beneficial to a contractor at one time may not fit his program at another time. Competition can quickly change the class of work an individual contractor finds worth figuring.

Contractors are in business to make money. Naturally, competition is a limiting factor. When projects come up for bid, the individual contractor must select work to estimate that will enable him to maintain his competitive standing.

Consider Theses Factors

Before contemplating a project-estimate, a contractor first must consider his ability to properly carry on the work involved in the job. Once that point is settled, the following factors should be taken into account:

1. Estimating cost
2. Engineering cost
3. Hazards involved
4. M/L (material-labor) ratio
5. Duration of job

6. Effect of existing work
7. Possibility of future business
8. The general contractor
9. The architect
10. The competition

Estimating - Engineering Cost. Some engineering always goes along with estimating. Such engineering will be considered included in the term "estimating" as used in this discussion.

If several jobs are figured and only one is obtained, that one must carry the estimating cost of the lot. Usually, estimating cost is greater for jobs obtained from general contractors than for those obtained from architects and owners. Prime reason: the generals take more bids and the chances of securing a contract are less.

Assume that it costs $100 to estimate a given job. If an architect or owner asked for three bids, the chance of getting the contract would be one out of three. Total estimating cost (three bids) would be $300. If a general contractor handled the electrical work and asked for ten bids, total estimating cost (10 bids) would be $1,000 and the chance of getting a contract would then be one in ten.

Some job are so difficult to figure that, with keen competition, one is not justified in gambling the estimating time. Then again, these same jobs may prove "desirable" because competition is frightened away and the limited number of bidders will figure high.

Hazards Involved. Most contracts involve some potential hazards. Risks of alteration work were noted in Part I of this article. There are potential hazards associated with most all construction work. Among them are: uncertain labor markets, strikes, job shut-downs, rising material prices, and a number of others. Any factor that will cause work to get out of hand and create excess expense is a hazard.

M/L Ratio. The material-labor ratio on a specific job is of prime importance. Studies show that, on a dollar basis, it costs less to supply material than it does to supply the labor and labor services needed to install the material. For this reason, jobs with a high ratio of material generally are considered more desirable than those with less material and more labor.

Installation-Only projects (material by owner, labor and labor services by contractor) usually are less desirable than contracts covering the complete electrical installation. Among the principal reasons for this are: 1) greater hazards are involved; and 2) the contractor's volume is reduced. A contractor is equipped and organized to supply and handle both material and labor. If he supplies only labor and labor services, he will be able to take care of less than half his normal volume. (For a more detailed account of this subject, see Electrical Estimating—McGraw-Hill Book Co.).

REPAIR SERVICES
(Electrical)

STUDY OF OPERATING COSTS FOR BUSINESS AS FOLLOWS:-
4 MECHANICS (AV.) EMPLOYED 40 HRS. $3.80 PER HR. AV. WAGE
DIV. OF BASE COST - 30% MATERIAL (PUR. PRICE), 70% LABOR (PAYROLL)

ANNUAL VOLUME - BASE COST

PAYROLL	$31,620. - 70%
MATERIAL	13,550. - 30%
TOTAL	$45,170.

OPERATING COSTS

ITEM	REMARKS	COST PER YEAR DOLLARS	DIVISION: MATERIAL DOLLARS	MATERIAL %	LABOR DOLLARS	LABOR %
ADMINISTRATIVE						
SUPERVISION						
ENGINEERING	By Prop. $200./Wk.	10,400	2,080		8,320	
ESTIMATING						
PURCHASING						
SELLING						
STORE ROOM ATTENDANT						
BOOKKEEPING - GENERAL						
BOOKKEEPING - SP. TAXES	$75./Wk.	3,900	1,170		2,730	
STENO & OFFICE ATTENDANT						
RENT - OFFICE						
RENT - STORE ROOM	$100./Mo.	1,200	360		840	
LIGHT	$15./Mo.	180	54		126	
HEAT		300	60		240	
TELEPHONE	$20./Mo.	240	48		192	
OFFICE FURN. & EQPT.	0.25% of $45,170.	113	23		90	
STORE RM. BINS, RACKS, ETC.						
STATIONERY & SUPPLIES	0.50% of $45,170.	226	46		180	
POSTAGE	0.40% of 45,170.	181	36		145	
TAXES & LEGAL EXPENSE	0.25% of 45,170.	113	23		90	
ADVERTISING & DONATIONS	0.20% of 45,170.	90	18		72	
COLLECTING BAD DEBTS	0.10% of 45,170.	45	11		34	
INT. ON PAYROLL	0.50% of 31,620.	158			158	
TRAVEL EXPENSE	Light Truck	1,200	420		780	
CARTAGE						
TOOLS - CONSUMED & DEPR.	2% of 31,620	632			632	
MISCELLANEOUS		200	40		160	
TOTALS		19,179	4,389		14,789	

TOTAL OPERATING COST - 42.4% OF COMBINED LABOR & MATERIAL COSTS
MATERIAL SERVICE COST - 32.4% OF MATERIAL (PUR. PRICE)
LABOR BURDEN - 46.7% OF LABOR (PAYROLL)

NOTE:- INSURANCES INCLUDED IN PAYROLL

FIG. 2. Typical study of operating costs of an electrical repair service business. While remunerative markups are hard to sell, this type of "undesirable" business often leads to valuable contracts.

Job Duration. In the previous article, short job duration was noted as a desirable factor. All electrical installations have an optimum duration period for economic operation. The table and chart in Fig. 1 list such periods for contracts within a given range of manpower requirements. Smaller contracts also have optimum duration periods.

When selecting contracts, one must consider the length of time key men and construction equipment will be tied up. Slow-moving work limits the possible volume a contractor can do. When job duration is extended, costs begin to climb (see Electrical Estimating—McGraw-Hill Book Co.).

Effect on Existing Work. A contractor must estimate and seek contracts that will fit in with his existing work. For efficient operation, he must maintain an even flow of work to keep his installation crews intact and his equipment facilities busy. As one job nears completion, there should be another to absorb the manpower. However, he must guard against taking on so much

[Continued on page 189]

Electric Heating Costs:

Calculating Floor Losses

Suggestions for improving the accuracy of electric heating cost estimates through a refinement of floor loss computations.

By Glydewell Burdick, *Wisconsin Power & Light Co., Madison, Wis.*

RELIABLE data indicate that electric heating energy consumption per degree-day rises materially during mild heating weather of late spring, when one would expect that the heat loss of the house would largely be offset by internal heat from miscellaneous sources.

The logical explanation for this apparent contradiction lies in the loss of heat from the house to the colder foundation and ground—*a loss which cannot be measured by degree-days based on outdoor air temperature.*

A simple example will serve to illustrate the error which is involved in direct application of the NEMA formula to floor losses. Assume that the design heat loss of a floor in the southern Wisconsin area is 1 kw figured at 30 deg temperature difference; the outdoor design temperature difference is 85 degrees; and the degree-days for the area are 7200.

The NEMA formula suggests that the annual energy loss through the floor would be

$$\frac{1 \text{ kw} \times 7200 \text{ DD} \times 18.5 \text{ hrs/day}}{85 \text{ deg TD}}$$

or 1567 kwhr per year. Dividing by 85 deg TD as above, when the actual temperature difference assumed was only 30 degrees, is outright error. Also, using 7200 degree-days when this figure does not measure the temperature difference to crawlspace or basement is outright error. The result is a gross understatement of floor heat loss energy. Even if figured with 24 hrs/day instead of the correction factor of 18.5, the annual energy would be 2033 kwhr, which is still a gross understatement.

As will be shown below, the *average* temperature difference through the floor in this area is about 70% of the *design* temperature difference. (This figure may vary in other climates.) If, as above, we calculate our heat loss on the basis of a 30-degree temperature difference, we can expect an average seasonal temperature difference of 21 degrees. Assuming an 8-month heating season (5760 hours), the annual energy through the floor would be

$$\frac{1 \text{ kw} \times 21 \text{ deg TD} \times 5760 \text{ hrs}}{30 \text{ deg TD}}$$

or 4032 kwhrs per year.

This is a far cry from the initial calculation of 1567 kwhrs obtained using degree-days and outdoor design temperature. Obviously the usefulness of the NEMA formula

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The author, in the August 1959 issue of *Electrical Construction and Maintenance*, suggested three ways of improving the NEMA formula for estimating electric heating costs: (1) remove the heat gain due to the miscellaneous use of electric energy in the home from the "correction factor" of the formula and treat it separately; (2) compute the annual energy loss of the floor separately from that for the rest of the structure; (3) for ceiling cable jobs, compute the annual energy loss of the ceiling separately from that for the rest of the structure. He then went on to treat the first of these three points in some detail.

This article is concerned with the second point, analyzing the problems involved in evaluating annual floor energy loss.

—Editor

Table 1. Crawl Space Average Temperature

Floor area: 1200 sq ft
Perimeter: 140 ft

Surface	Heat loss coefficient (Btu/hr/sq ft per deg TD)	Area (sq ft)	Temp. diff. (deg F)	Heat transfer* (Btu/hr)
1. First floor	.039	1200	(70 − T_a)	3276 − 46.8T_a
2. Wall above grade	.51	94	(36 − T_a)	1724 − 47.9T_a
3. Slab or ground	.10	854	(50 − T_a)	4270 − 85.4T_a
4. Wall below grade	.113	812	(43 − T_a)	3947 − 91.8T_a
			Total heat gains and losses =	13,217 − 271.9T_a

* The coefficient of T_a for each surface in the last column above, being the product of the heat loss coefficient and the area, represents Btu/hr/deg TD, which is used for calculating the values of Table 3.

Solution to Equation	Average Temperature Differences (deg F)**
13,217 − 271.9T_a = 0 271.9T_a = 13,217 T_a = 48.6F This is the temperature of the crawl space to be used in estimating annual energy loss and heating costs.	1. First floor 70−48.6=+21.4 2. Wall above grade 36−48.6=−12.6 3. Slab or ground 50−48.6=+ 1.4 4. Wall below grade 43−48.6=− 5.6 **Minus sign indicates that a loss of heat will take place; plus sign a gain of heat.

Crawl Space Temperatures
(Average over Heating Season)

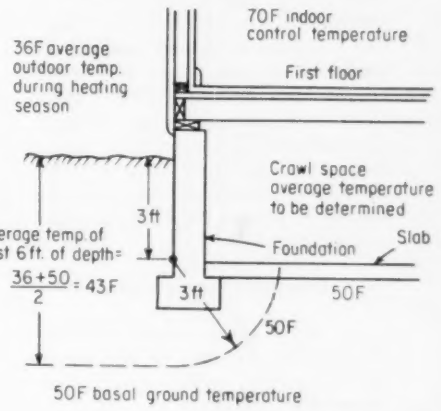


Table 2. Crawl Space Design Temperature

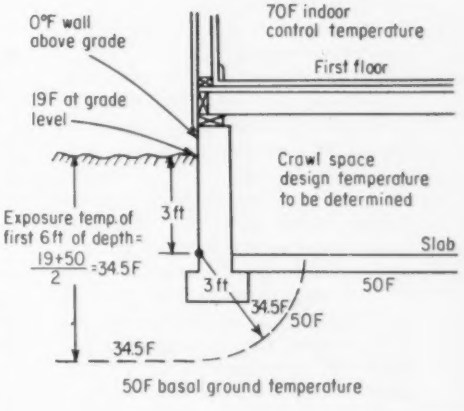
Floor area: 1200 sq ft
Perimeter: 140 ft

Surface	Heat loss coefficient (Btu/hr/sq ft per deg TD)	Area (sq ft)	Temp. diff. (deg F)	Heat transfer* (Btu/hr)
1. First floor	.039	1200	(70 − T_d)	3276 − 46.8T_d
2. Wall above grade	.51	94	(0 − T_d)	0 − 47.9T_d
3. Slab or ground	.10	854	(50 − T_d)	4270 − 85.4T_d
4. Wall below grade	.113	812	(34.5 − T_d)	3166 − 91.8T_d
			Total heat gains and losses =	10,712 − 271.9T_d

* The coefficient of T_d for each surface in the last column above, being the product of the heat loss coefficient and the area, represents Btu/hr/deg TD, which is used for calculating values of Table 4.

Solution to Equation	Design Temperature Differences (deg F)**
10,712 − 271.9T_d = 0 271.9T_d = 10,712 T_d = 39.4F This is the crawl space temperature to be used in determining the capacity of electric heating equipment required.	1. First floor 70−39.4=+30.6 2. Wall above grade 0−39.4=−39.4 3. Slab or ground 50−39.4=+10.6 4. Wall below grade 34.5−39.4=− 4.9 **Minus sign indicates that a loss of heat will take place; plus sign a gain of heat.

Crawl Space Temperatures
(Design Condition)



depends upon errors in one direction being offset by errors in the opposite direction, all wrapped up in the correction factor. If the accuracy of cost estimates is to be refined, however, this error in floor heat loss energy must be recognized and eliminated.

Heat loss to foundations and basement floor goes on much of the year, including the summer, in all areas having a basal ground temperature (well-water temperature) below 70F. For the same reason, an enclosed but unheated crawl space or basement will *receive* heat from the ground whenever in severe weather the space temperature is below that of the ground.

The example above indicates that, to accurately estimate floor losses, we must know the temperature difference between the heated space and the unheated space below the floor—both for the *average* condition (for estimating costs) and for the *design* condition over the heating season (for specifying equipment capacities).

The underfloor temperature for both conditions may be computed by (1) setting up equations of heat transfer for the crawl space or basement surfaces with the space temperature as the unknown; and (2) making use of the fact that, since no heat is generated within the underfloor space, the sum of the heat gained and heat lost will be zero.

Heat transfer will occur through four surfaces:

(1) the first floor
(2) the foundation wall below grade

(3) the slab
(4) the foundation wall above grade.

The first step must be to agree on the exposure temperatures acting upon these four surfaces. In the absence of better laboratory and field test data on outside foundation temperatures just above and below ground level, assumptions will have to be made. The following analysis of an unheated, unventilated crawl space is based on southern Wisconsin climate conditions and may be applied to other areas using appropriate local data.

Average Temperature

(1) First floor. The exposure temperature to the heated space above the floor is 70F, the indoor design temperature.

(2) Foundation wall above grade. The average exposure temperature for the wall above ground level, including any window areas, is taken as the average outdoor temperature over the heating season—in this case 36F.

(3) Slab. The exposure temperature for the slab center or ground center under the house is taken to be the basal ground temperature (usually the temperature of well water in the area). For southern Wisconsin, this value is 50F.

(4) Foundation wall below grade. The outer surface of the first 6 ft of foundation wall (or, for shallow crawl spaces, the wall plus the strip of slab within six feet of the surface) may be considered to be at a temperature equal to the average of the basal ground temperature and the average outdoor temperature during the heating season. For a 36F average outdoor temperature and 50F basal ground temperature, the outside of the foundation wall would be taken to be

$$\frac{36 + 50}{2} = 43\text{F}.$$

Calculations. Heat transfer equations to be set up are of the form

Heat loss coefficient × area × temp diff = heat transfer

or

(Btu/hr/sq ft/deg TD) × (sq ft) × (t − T_a) = Btu/hr

where

t = *average* exposure temperature
T_a = crawl space *average* temperature to be determined.

Table 1 shows this equation set up for all four areas of heat transfer. Since the heat gained by the crawl space is equal to the heat lost, the total gains and losses (obtained by adding the four equations) may be equated to zero and solved for T_a. The table shows a crawl space average temperature of 48.6F.

Design Temperature

(1) First floor. The exposure temperature to the heated space above the floor is 70F, as before.

(2) Foundation wall above grade. That portion of the outside wall

Table 3. Heat Transfer
(Average over Heating Season)

Surface	Calculations	Heat transfer (Btu per hr) Gains	Losses
1. First floor	46.8 Btu/hr/deg TD x 21.4 deg TD =	1001	
2. Wall above grade	47.9 Btu/hr/deg TD x (−12.6 deg TD) =		604
3. Slab center	85.4 Btu/hr/deg TD x 1.4 deg TD =	120	
4. Wall below grade	91.8 Btu/hr/deg TD x (− 5.6 deg TD) =		514
	Total heat transfer =	1121 Gain	1118 Loss

Heat transfer through each of the four surfaces, averaged over the heating season, is calculated as above using the heat loss per deg TD and the design TD values of Table 1. The heat gains are approximately equal to the losses, consistent with the accuracy to which the calculations were carried.

Crawl Space Heat Transfer
(Average over Heating Season)

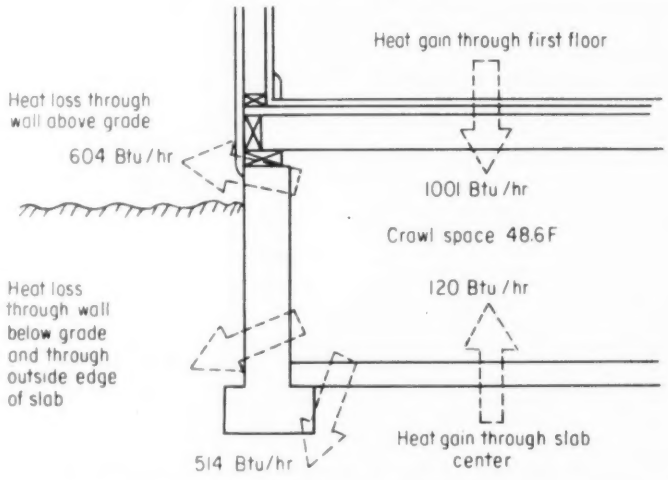


Table 5. Average vs Design Heat Losses

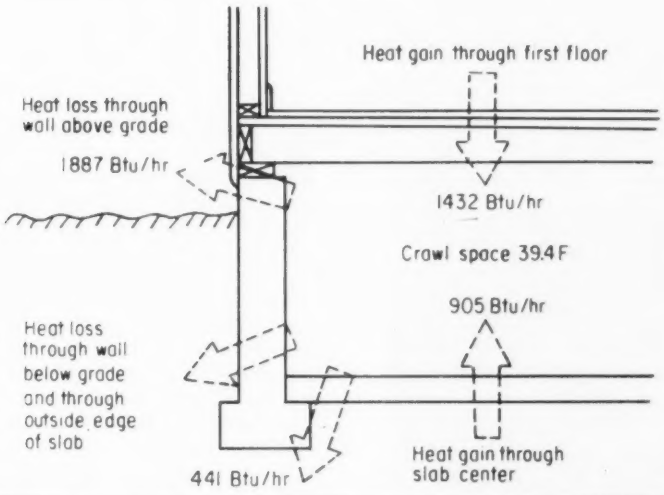
Area (sq ft)	Floor insulation (inches)	Computed heat losses (Btu per hr) Season Average (A)	Design (B)	Multiplier to apply to (A) to give (B)
600	3	810	1205	1.49
	6	534	795	1.49
1200	3	1490	2150	1.44
	6	1010	1440	1.43
2400	3	2820	3930	1.39
	6	1907	2650	1.39

Table 4. Heat Transfer
(Design Condition)

Surface	Calculations	Heat transfer (Btu per hr) Gains	Losses
1. First floor	46.8 Btu/hr/deg TD x 30.6 deg TD =	1432	
2. Wall above grade	47.9 Btu/hr/deg TD x (−39.4 deg TD) =		1887
3. Slab or ground	85.4 Btu/hr/deg TD x 10.6 deg TD =	905	
4. Wall below grade	91.8 Btu/hr/deg TD x (− 4.8 deg TD) =		441
	Total heat transfer =	2337 Gain	2328 Loss

Heat transfer through each of the four surfaces at design condition is calculated as above using the heat loss per deg TD and the design TD values of Table 2. The heat gains are approximately equal to the losses, consistent with the accuracy to which the calculations were carried.

Crawl Space Heat Transfer
(Design Condition)



that is about 16 in. or more above grade (and any existing windows) should be assumed to be exposed to the design outdoor air temperature of the locality.

However, because of the massive heat storage capabilities of the foundation and adjacent earth, plus the movement of heat upward through the foundation from the warmer ground below, it appears excessive to use outdoor design temperature as the exposure for the first 16 in. or so of foundation exposed above the ground. An exposure temperature a few degrees above the mean temperature of the coldest day is suggested. As a typical example, a logical exposure temperature for an area with −15F outdoor design temperature and a coldest-day mean temperature of −5F would be 0 degrees F.

(3) Slab. As was done for the average condition, the exposure temperature for the slab or ground center under the house is taken to be the basal ground temperature (50F).

(4) Foundation wall below grade. Assuming that the basal ground temperature is reached at a depth of 6 ft below grade, the outer surface of the first 6 ft of foundation wall below grade may be considered to be at a temperature equal to the average of the basal ground temperature and the temperature at the grade point on the outside of the foundation. For reasons similar to those expressed in (2) above and also because of the presence of snow cover and surface duff on the ground, it is inappropriate to use the outdoor temperature of the coldest hour as the design temperature of this grade point. It is more reasonable to assume the design temperature of this point to be the average mean outdoor temperature of the coldest month. For southern Wisconsin, this temperature is 19F.

The design exposure temperature of the outside wall below grade would then be

$$\frac{19 + 50}{2} = 34.5\text{F}$$

Calculations. Heat transfer equations and computations follow the same procedure as outlined under "Average Temperature" above and are summarized in Table 2, which shows a resultant design temperature of 39.4F.

Summary

The above procedure suggests a logical but complex approach to finding (1) the *average* temperature difference over the heating season between the heated area and the unheated, unventilated underfloor space for use in estimating that portion of the heating cost due to losses through the floor; and (2) the *design* temperature difference between the heated area and the underfloor space for use in computing heat loss through the floor to size the heating equipment.

The separate calculation of the underfloor design temperature may not be necessary after enough installations for a locality have been computed. A multiplier may be used with the computed average hourly floor heat loss for the heating season to obtain the design floor heat loss. In this connection, Table 5 shows the relation of design to average hourly floor heat loss for six sample residences varying in floor area and floor insulation. It seems safe to conclude that, for the locality and type of construction given, the seasonal average heat loss per hr may be multiplied by about 1.45 to obtain the design heat loss.

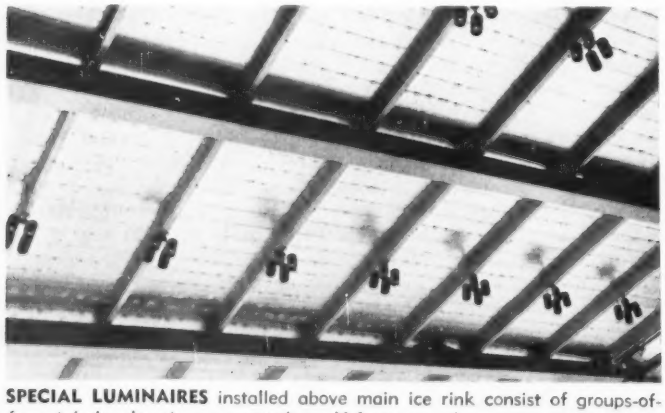
If, as appears probable, we have been estimating annual heat loss through the first floor at about 40% of its actual value, more floor insulation is warranted than the 2 in. (or U = .089) which is now generally accepted. Calculations of insulation cost versus energy savings show that 6 in. of floor insulation (U = .039) are entirely practical and economically sound for the climate of southern Wisconsin. Farther south the right answer may not be 6 in., but it is more than two.

Power for the Winter Olympics

Squaw Valley, site of the 1960 Winter Olympic Games, represents a $16-million investment in facilities that include dozens of special-function buildings, four skating rinks and five ski-lifts served by a 480-volt distribution system. Electrical features include numerous applications of electric heating with a 2-way heat-exchange system, low-decibel transformers, high-altitude emergency generators, special lighting, and elaborate electronic data-processing and timing equipment.

By George Retter, Jr., *Engineer, Fischbach and Moore, Incorporated, Pittsburg, Calif.*

CONSTRUCTION VIEW of arena grandstand shows warm-air duct openings beneath each seating tier on 6-ft centers, also camera decks, TV and radio booth at top-center, and hanging framework for suspended scoreboard at right. Arena, with seating capacity for 8,500, will be scene of major Olympic ceremonies, figure skating and ice hockey contests. Electrical, mechanical and refrigeration equipment is located at various levels beneath stands.



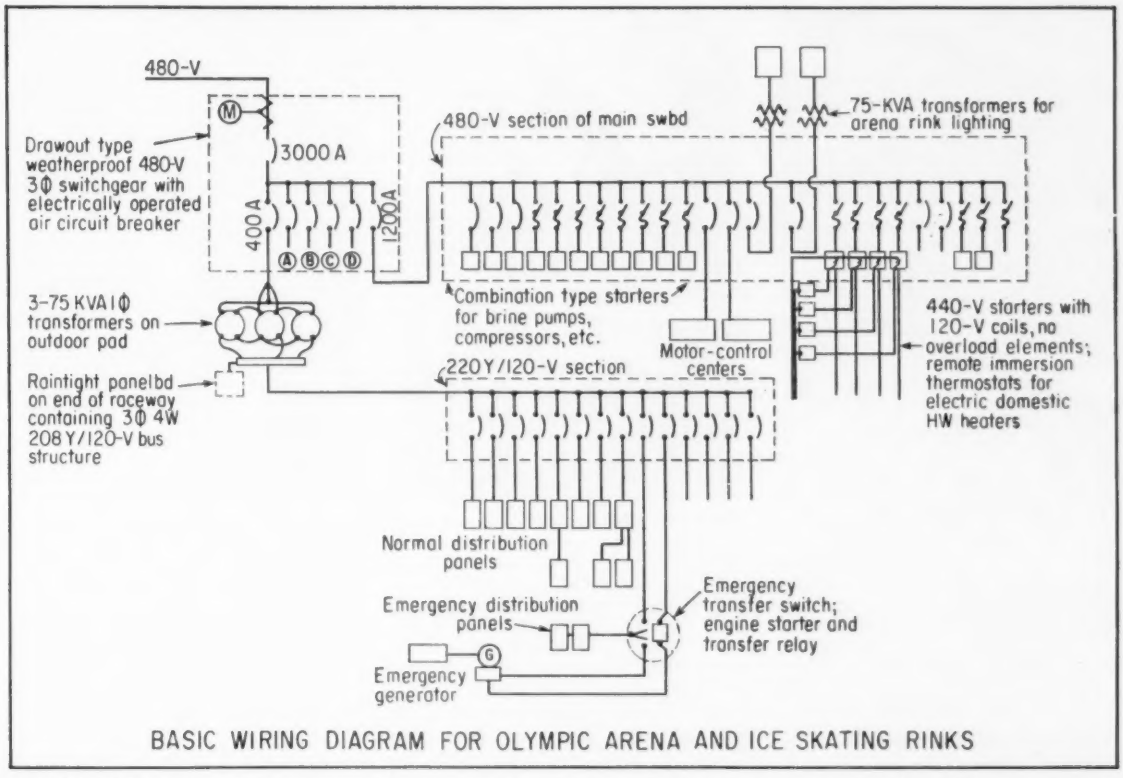
SPECIAL LUMINAIRES installed above main ice rink consist of groups-of-four tubular housings mounted to X-frames and square center plates. Housings, measuring 11 by 19 in., contain 800-watt narrow-beam reflector lamps, while inside surfaces are black enameled to eliminate reflection.

WHEN the 8th Olympic Winter Games is contested this coming February, eyes of the sports world will focus upon a small craggy valley in California's high Sierra Nevadas. A few years ago this tiny ski center was practically unknown, yet today it represents a $16-million investment in top-flight facilities for the convenience and comfort of 800 competitors and a daily spectator population of 35,000.

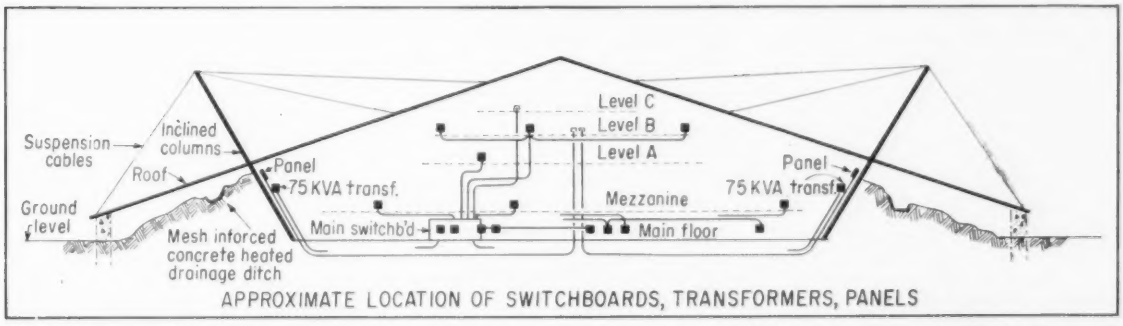
Including an 8,500-seat enclosed skating arena plus four additional outdoor ice-skating rinks, five chair lifts radiating to summits of surrounding mountain peaks, dormitories and recreational provisions for athletes and officials, several lodges and restaurants, elaborate provisions for press, radio and TV coverage, a 1200-telephone exchange involving 60-million ft of wire, plus numerous electrical and mechanical highlights, this rugged snow-bowl will provide an impressive setting wherein international skiing and skating honors will be decided.

Electrically, interest centers upon general power distribution and control, the use of high-altitude emergency generators and low-decibel spectator-area transformers, electronic timing and data-processing equipment, many applications of electric heating, special lighting techniques and a dual-purpose heat exchange system that can variously refrigerate ice, melt snow and warm space.

Primary distribution throughout the valley is at 480 volts, major



PRIMARY POWER is carried through weatherproof outdoor switching station to 480-volt section of main switchboard inside arena and is stepped to 120/208 volts for lighting and receptacle use by bank of single-phase transformers; entrance into building is via walk-through tunnel that also contains mechanical piping. Emergency power is available through automatic transfer switch and high-altitude diesel generator. Most motorized equipment is controlled remotely.

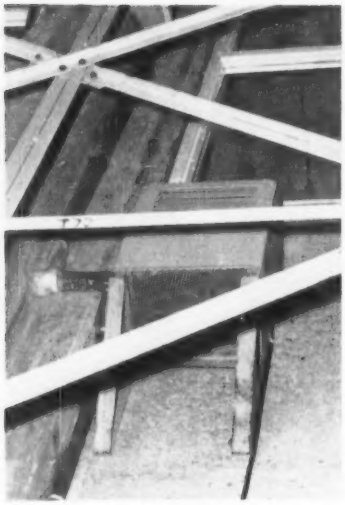


MAIN SWITCHBOARD, refrigeration and emergency power equipment, control center and electrically heated domestic-water tanks are located beneath permanent grandstand, as shown, while local panels at various levels supply electrical needs to radio and TV alcoves, concession booths and scoreboards, office and maintenance areas. Note dry-type transformers mounted against inclined columns, also heated drainage ditches beneath eaves of cable-suspended roof.

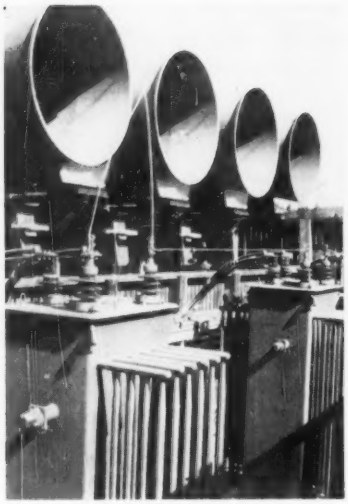
switchgear and transformer stations serving such load centers as administration, transportation and press buildings, an extensive athletes' village, ski lodge and officials' living area, and a main arena surrounded by four satellite ice rinks.

This latter load center, the largest, consists of an outdoor switching station with pad-mounted oil-filled air-cooled transformers; a tunnel and feeder bank entering the arena underground; a 2-section interior board for 480- and 120/208-volt service; emergency power equipment including generator, transfer switch and relays, also secondary dry-type 75-kva transformers for arena lighting.

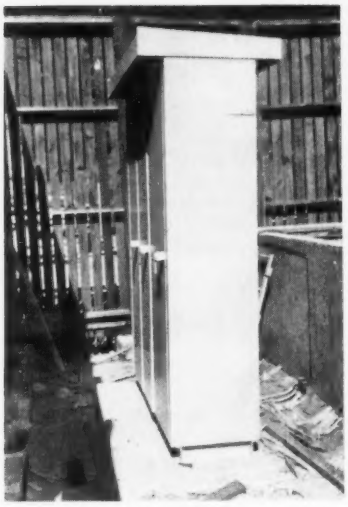
In this setup, primary service is obtained through eight 500 MCM cables supported by a covered tray which is rear-connected to a 3-phase switchgear assembly consisting of a 3000-amp main CB plus six feeder breakers. All breakers are electrically operated air units. One (1200-amp) serves the 480-volt section of the main indoor switchboard directly; another (400-amp) extends to an adjacent bank of single-phase transformers with insulated bushing-type terminals, raintight panelboard and bus structure related to the 120/208-wye section of the indoor board; and the remaining four feeders serve such separate facilities as spectator centers and data-processing



DRY TYPE TRANSFORMERS related to main rink lighting are 75-kva low-noise-level units mounted against inclined side walls of arena, being supported by welded-angle frames and preset bolts. Control panels for same mount against columns at a higher elevation, with square raceways extending to roof-level pull-boxes.



OUTDOOR SUBSTATION includes bank of oil-filled air-cooled single-phase transformers in pad-mounted fenced enclosure that also surrounds air-evaporator and condenser installation. As noted, coils have separate fans and enclosures to prevent intermixing of air and formation of ice during inoperative periods.



RAINTIGHT SWITCHGEAR at outdoor substation is mounted on channels partially embedded in reinforced-concrete base. Feeders from this assembly are then carried downward to duct bank incorporated in walk-through tunnel extending from outdoor station to main switchboard located inside arena.

stations, first-aid structures and exterior lighting.

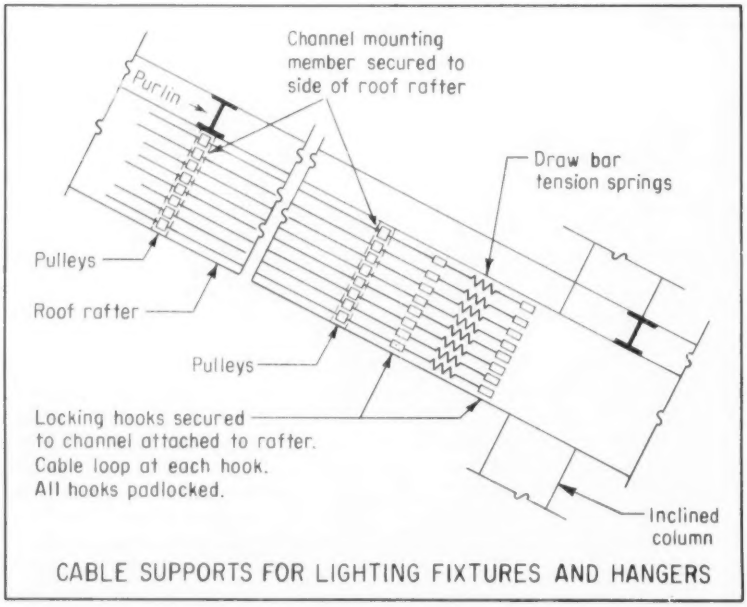
Due to prevalent climatic conditions, all outdoor equipment is weatherproofed, switchgear being channel mounted with upper flanges of supports extending above a slab of 10-in. reinforced concrete set on a crushed-rock sub-base. All non-current-carrying enclosures and exposed metal components are grounded via No. 2 bare stranded copper cable connected to rods driven at each corner of the slab. Unions between ground rods and cables are established via pressure connectors, while number of rods was predicated on ground resistance of less than 25 ohms.

Feeders carried underground into the arena are contained in banks of 4-in. non-metallic ducts cradled on Transite saddles and encased by a 3-in. concrete envelope. Where feeders sweep upwards to bottom-connect with switchgear, ducts first connect with adapters and rigid steel galvanized ells embedded in the concrete envelope.

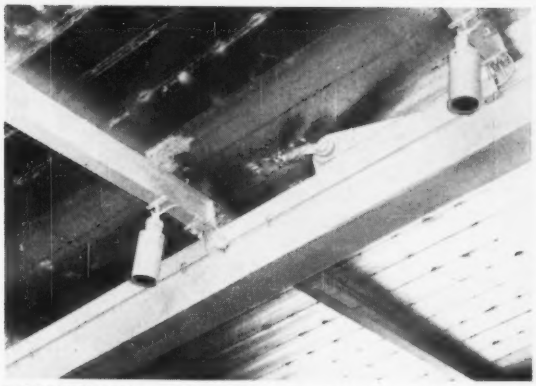
Major portion of the main switchboard consists of a 440-volt motor control section with breaker-starters related to (1) compressors and brine, circulating, vacuum and purge pumps, (2) two additional remote MCCs, (3) two 75-kva secondary transformers for rink lighting, plus (4) 440-volt breaker-starters equipped with 120-volt relay coils but without overload elements, these breakers being linked with immersion thermostats controlling four 24-kw domestic hot water units.

Breakers on the 120/208-volt section of the board operate light remote distribution centers and three sub-panels, an outdoor timers' shelterhouse located at the edge of the speed-skating rink, and emergency-lighting equipment.

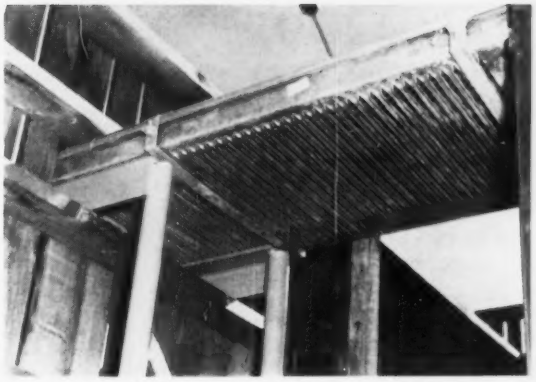
In general, 120/208-volt distribution centers serve lighting, scoreboard control, receptacles, sump pumps and (in kitchens and concession booths) cash registers,



LIGHTING FIXTURES above ice rink are supported by lowering hangers and cables equipped with drawbar tension springs and locking hooks secured to lipped-channel mounting members and padlocked to prevent tampering by unauthorized personnel.



DISCONNECTING HANGERS permit lowering of luminaires for relamping, while leveling pads insure vertical alignment of fixtures whether they are mounted on purlins or against inclined structural members. Note method by which supporting cables for roof are attached by clevis sockets to main box beams. Cellular roof decking permits internal circulation of warm air, thereby preventing ice formation.



PRIMARY SERVICE for outdoor substation is obtained through a specially designed cable tray that rear-connects to cubicle housing electrically operated main circuit breaker. Note that tray is solidly covered on top as shield against rain and snow; louvered on the bottom for ventilation purposes. The cable tray contains eight 500 MCM cables per phase, which are run in multiple to the 3000-amp main circuit breaker.

refrigerators and freezers, food warmers and steamers, ice cabinets and coolers, coffee urns and water kettles.

High-Altitude Generator

Due to the 6200-ft elevation of Squaw Valley, the 4-stroke water-cooled diesel engine (which is flexibly coupled to a 30-kw emergency generator) is a drive unit designed for high-altitude service. This unit, automatically started by a heavy-duty 150-amp-hour 12-volt battery, is controlled through action of a load-transfer switch, contactors of which are interlocked both mechanically and electrically so that normal and emergency power sources cannot feed emergency feeders simultaneously.

The 75-kva dry type transformers serving rink lighting are 45-decibel units supported by welded-angle frames secured by preset bolts to outward-slanting concrete walls located behind side-arena bleachers. Control panels for same are placed directly above, mounted against inclined columns that brace roof-supporting suspension cables.

Above these panels, 4- by 4-in. raceways extend upwards to large pullboxes placed at roof-beam level, with separate branch conduits extending outwards along purlins from these PBs to arena lighting fixtures. In this detail, panels are offset so that raceways can go straight into boxes, entrance into same being effected through collars and slip-fittings.

Basic lighting fixture used for arena and rink lighting is a specially designed unit consisting of four large tubular annular-louvered, steel-shell housings jointly supported by aluminum crossarms secured by machine bolts to square center plates. Housings, measuring 11 in. in diameter and 19 in. in height, are sherardized and chromated, with insides enameled black and with mogul sockets holding R-57/3 narrow-beam 800-watt reflector lamps. Axis of lamps is generally perpendicular although, when special emphasis or highlighting is desired, the axis is purposely offset.

These central arena fixtures are equipped with disconnecting and lowering hangers complete with sheaves and provisions for direct connection with conduit raceways. Leveling pads are likewise provided so hangers will remain vertical whether mounted against purlins or inclined structural members, while lowering cables are equipped with drawbar tension springs and locking hooks secured to lipped-channel mounting members placed alongside roof rafters.

Lowering cables are carried in conduit down to maintenance boxes placed 5 ft above main-floor level, all cable hooks being padlocked to prevent tampering by unauthorized personnel.

This same basic fixture is used in other locations as well, except that housings are then mounted singly. Lamps are 550-watt R-57s, and tubular shells are decoratively perforated with 5-ring Olympic insignias for ornamentation.

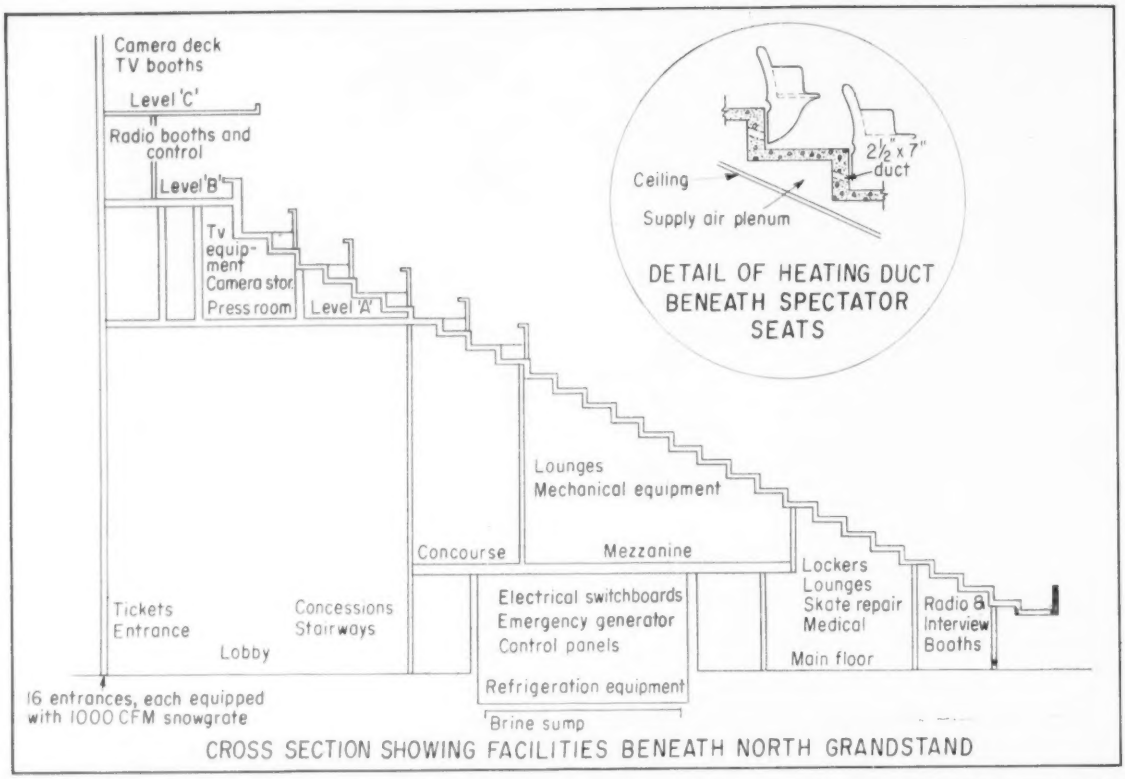
Since heating is required to prevent snow from piling up on the arena roof as well as to warm spectators within that structure, and since refrigeration is essential to maintain ice on outdoor as well as interior skating rinks, the heating, refrigeration and ventilating system was designed as a dual-purpose heat exchanger.

By this arrangement, heat extracted from brine-chilling condenser coils may be used to warm certain areas. And, when heat so extracted is not sufficient to supply the demand, additional (or even total) heat may be extracted from outside air. In addition, electric heating and pre-heat coils are provided in various air plenum chambers so that either fresh or recirculated air may be raised in temperature, blended by motor-operated dampers, and routed as required by squirrel-cage rotary fans.

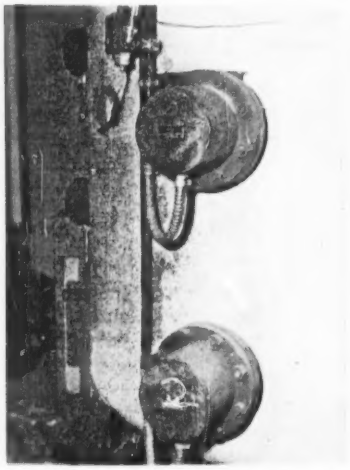
Conversely, when the heating load is insufficient to condense hot refrigerant gasses, the additional (or total) load may be obtained from outdoor condensing units.

This system was designed to handle 26,000 cfm of fresh air at minus 5 degrees F with a humidity of 85%, warming this air to comfort level through four heating coils having combined capacities of 4 million Btu per hour.

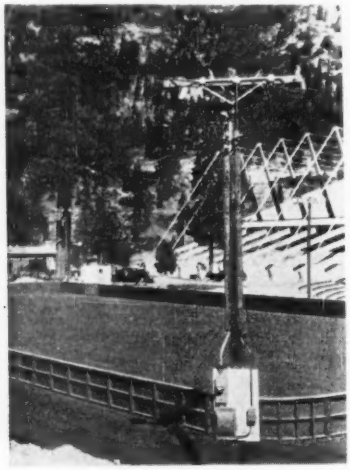
Brine for the four ice rinks (three outdoor plus one indoor) is chilled to a temperature of 14 degrees, circulated through series of valves and pumps at the rate of 5500 gpm, then returned to a brine sump for re-chilling. Chilling is



CROSS-SECTION through permanent grandstand shows approximate positioning of electrical, mechanical and refrigeration equipment, radio and television facilities, heating ducts beneath spectator seats and snow-melting ducts and grates beneath series of entrances to main lobby of arena. Underseat heating details are shown in inset.



IMMERSION HEATING UNITS installed inside domestic hot water tanks are 24-kw 440-volt assemblies regulated by thermostatic elements and MCC breaker-starters equipped with 120-volt relay switching coils. Tanks are located beneath permanent grandstands in service room that also contains compressors and refrigerating equipment, emergency generator and sectionalized switchboard. Short lengths of flexible metal conduit connect heater housings to the supply conduits. Immersion thermostats operate the contactor holding coils.



OUTDOOR HOCKEY RINK is illuminated for night practice by pole-mounted floodlights controlled through local weather-proof switch panels and served by trench-laid feeder cables in conduit. Small shack seen near pine tree in left background houses local weather-station indicating and recording equipment. Although normal winter temperatures should produce excellent skating surfaces, all five ice rinks are provided with brine-circulating coils as double insurance against ice melting.

accomplished by a shell-and-tube cooling unit (brine in tubes, refrigerant in shell) with the refrigerant passing through two centrifugal compressors collectively rated to provide 550 tons of refrigeration and to raise the temperature of air leaving condenser coils to at least 100 degrees F.

Drive unit for the first-stage compressor is 200 hp with a maximum allowable overload of 10%, while the second-stage motor is a 1000-hp unit.

To handle fresh-air heat extraction or condensing loads, an outdoor air-evaporator and condenser installation is formed with light coils, each coil provided with separate fan and enclosure to prevent ice and sleet from forming on fans when they are inoperative, and to prevent air from adjacent coils from intermixing. A ninth coil is provided for use during defrosting cycles.

Heart of this comprehensive heating, ventlation and refrigeration system is a central-control color-graphic panel containing a complete layout (in colored lucite)

of all equipment, ducts and piping, all components plainly identified by color-filled engraved symbols and legends.

Controls incorporated in this panel (for remote operation of all equipment) are related to compressors, pumps (brine, oil, domestic water), fans (supply, circulating, exhaust) and dampers. Panel control and monitoring devices include pressure and suction gages, start-stop miniature switches, pushbuttons with indicating pilot lights, multispeed fan controls, zone controls with locking positions to operate dampers of hot and cold air in 15 mixing plenums, and controls to integrate various damper settings with outputs of related pre-heat coils.

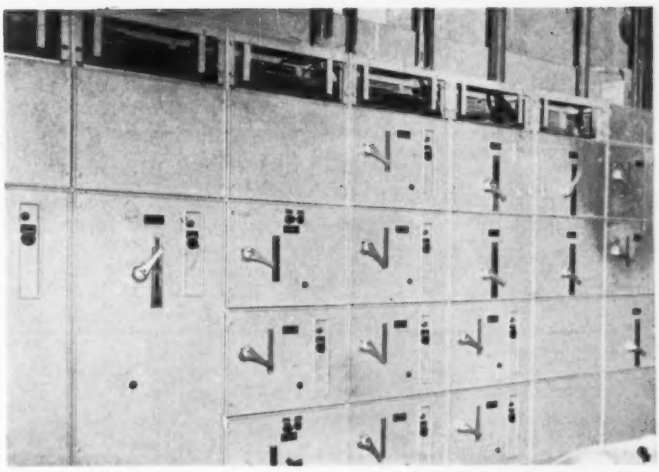
Air in the arena can be (1) exhausted completely, blended with fresh air, or totally recirculated for fast warm-ups; all dampers being equipped with fusible-link gravity-closing firedoors, and air intakes protected by bird screens; (2) directed through plenums located beneath seating areas and then fan-forced through duct openings located on 6-ft centers beneath each row of seats for greater spectator-comfort; or (3) circulated through cellular roof decking for snow-melting purposes.

This comprehensive heating system is additionally augmented by (1) snowgrates at 16 bi-parting entrance doors, each grate having a capacity of 1000 cfm or warm air at 100 degrees to melt snow from shoes of incoming spectators, (2) a dozen radiant heating lines beneath each of two large drainage ditches that extend beneath roof eaves for the full length of the arena, and (3) two electric heating units with combined capacities of 1½ million Btu per hour to furnish 140-degree domestic hot water to kitchens, first-aid, concession and restroom areas.

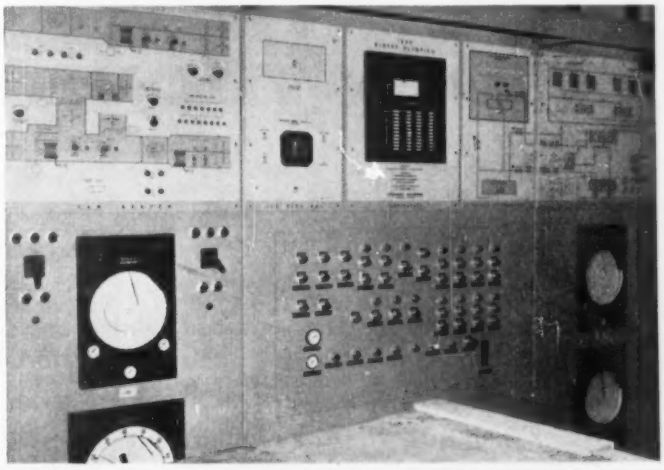
The arena is a massive 300- by 460-ft structure with the north (permanent grandstand) end enclosed by glass and colored-metal panels, and with the south end equipped with movable bleachers that can be rotated inwards to enclose the central rink, or swung outwards to face the speed-skating oval. The cellular roof (designed to combine warm-air snow-melting facilities with insulating interstices) has a steep slope of 30 degrees, a peak height above rink surface of 85 ft, and wide eaves that overhang the heated drainage ditches. Roof supports are provided by stranded steel cables extending upwards from cantilevered box-beams to clevis sockets atop 90-ft-high tapered, back-tilted pylons, then running downwards to reinforced-concrete anchoring piers.

In comparing possible sites for the winter games, the compactness of Squaw Valley was a definitely persuasive selling point, for spectators will be within a few minutes' walk of all competitive sites except cross-country events, eating places and rest lounges, while improved local highways and airports will provide convenient means for reaching nearby housing and recreational centers.

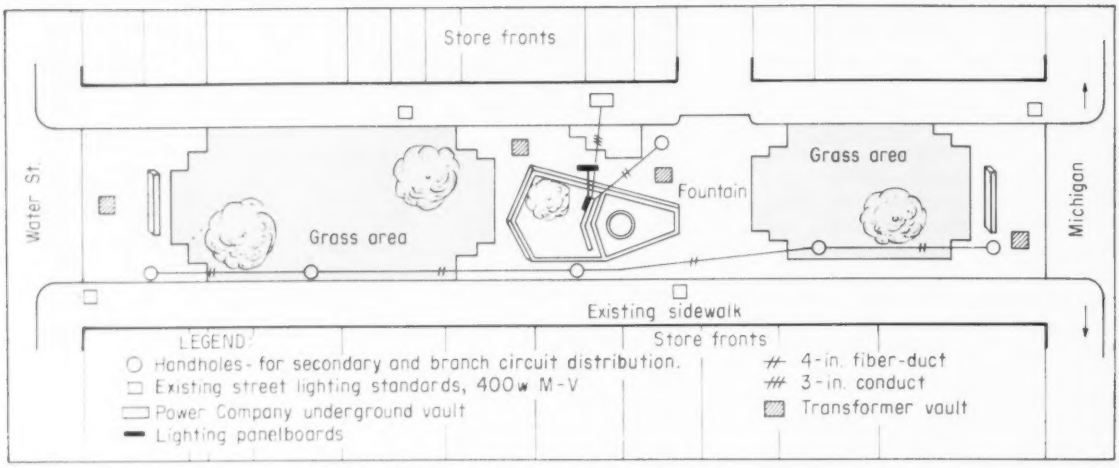
Designed by Corlett and Spackman, Kitchen and Hunt, Architects Associated of San Francisco, in collaboration with electrical and mechanical engineers Vandament and Darmsted, consulting engineers Punnet, Parez and Hutchison, and structural engineers Brunnier and Sardis, the Olympic facilities at Squaw Valley were powered and lighted by electrical contractors Fischbach and Moore, Inc. of Pittsburgh, Calif. and by Acme-Coline of Reno, Nev.



MOTOR CONTROL section of 440-volt interior switchboard contains breaker-starters related to compressors, numerous pumps, two other remote MCCs, secondary dry transformers for arena lighting, also several immersion hot-water heating elements. Cover plates removed from overhead wireway reveal cable connections between breakers and branch conduits.



COLORGRAPHIC control panel for heating, ventilation and refrigeration system contains mimic lucite layout of all equipment, also pressure and suction gages, start-stop miniature switches, pushbuttons with related pilot lights, multi-speed fan controls, zone controls for air-mixing plenums, and controls for integrating damper settings with outputs of pre-heat coils.



PLOT PLAN of a portion of the mall shows 4-in. fiber duct runs, handholes, power company vaults and existing street lighting.

Wiring Kalamazoo's Downtown Mall

The project features:

1 An underground duct-work system designed to provide unlimited access and expansion.

2 Various arrangements of outdoor lighting equipment to decorate, accent and highlight fountain-type pools, flower gardens, shrubbery and evergreens.

3 An existing 400-watt color-improved mercury-vapor street lighting system that has been retained provides general illumination throughout the mall.

BURDICK STREET in Kalamazoo, Mich., has become an attractive pedestrian shopping area—free of vehicular traffic and furnished with flower gardens, grass areas, playgrounds and fountain-type pools. And, business is on the up-swing, property values are improved—store fronts of shops bordering the mall are being remodeled at an astounding pace. Also, plans for a new million dollar store are being completed.

Actual construction of Kalamazoo's pedestrian mall was started June 1, 1959. The preparatory work of removing 14 in. of blacktop, brick and concrete between curbs 40 ft apart presented Rowen and Blair Electric Co. and local power and telephone companies with an opportunity to install their respective underground wiring and service facilities. This was a most important phase of the construction program, because electricity plays a major role in the mall's functional and artistic design.

Directly after all concrete, etc., was removed and after all piping, ductwork, manholes, and handholes were roughed-in and constructed, the entire area was back-filled with earth to raise the grade to the level of the sidewalks. Sections of the mall were then paved with 4-ft colored concrete blocks; large areas were covered with sod; trees, shrubbery and flower gardens were planted and large concrete block fountain-type pools and planters were installed.

Two blocks were involved. Each block's lighting is time-clock controlled and metered separately. The north block of Burdick Street is 264 ft long and the south block is 600 ft in length. The north block was completed first. Service for this section of the mall is fed underground from the Consumers Power Company's (local utility) vault located near the center of the block beneath the sidewalk area.

A 3-in. galvanized conduit encased in a concrete envelope is installed from the vault to a sub-distribution center hidden in the garden end of a combination garden and fountain-type pool. A steel cabinet, mounted

DICK CATHCART, engineer-estimator for Rowen and Blair Electric Co., is shown at one of the typical "handholes" (10-in. diameter) that his company installed to provide secondary and branch circuiting for the mall's electric system. Mushroom type outdoor lighting fixture in background (arrow) is fed from this handhole.

WIRING for the existing street lighting system (400-watt color-improved mercury-vapor) was unchanged except for the addition of a relay to switch on the mall's decorative lighting equipment at the same time street lights are energized by photoelectric control. Notice group of PAR-56 300-watt floodlights at top of pole (arrow).

ACCESS OPENING beneath stage leads to a distribution vault that serves the "long" block of the mall. Transformer and lighting panel installed here are fed from an existing utility manhole in an adjacent alley. When the stage is finished, its center part (12 ft in diameter) will revolve.

OVERALL VIEW (the "long" block looking north) shows staggered arrangement of the existing street lighting system, grass area and fountain-type pool. The above grade pool has two fountains, one at either end. Each of the fountains is illuminated by underwater floodlights with rotating color wheels.

on a masonry base holds the block's 120/240-volt lighting panel, meter and time clocks.

Distribution wiring from the cabinet to both ends of the block is in 4-in. fiber duct encased in a concrete envelope. At six points along the block the fiber-duct run connects to 12-in. deep bricked-up handholes that have 10-in. diameter cast iron covers which are set flush in the mall's surface. The handholes are built on a concrete foundation but have a gravel bottom fill to permit drainage.

Branch circuit wiring is run from the various handholes to weatherproof receptacles, an assortment of garden-type fixtures and floodlights, and underwater lights and submersible pumps installed in the pools. The branch circuiting is carried by two wires run in ½-, ¾- and 1-in. conduits. All conduit passing through the brick walls of the handholes are firmly cemented in and terminated with insulated bushings. Weatherproof FS boxes house duplex receptacles and also serve as junction boxes for the outdoor flood and accent lighting equipment.

Generally speaking, wiring for the "long" block was installed in exactly the same manner as the "short" block. The longer section of the mall has fifteen 10-in. diameter hand-access holes, while the shorter north end has only six. Service to the south block of the mall is brought in underground from an existing utility vault located in an adjacent alley. The 3-in. conduit run carrying the primary terminates directly below a large stage constructed near the center of the block. As the 480-volt, 3-phase, 3-wire primary enters the equipment vault below the stage, it is connected to a 15-kva, 3-phase transformer. The secondary output of the transformer is 120/208-volt, 3-phase, 4-wire and is the utilization voltage for this section of the mall's overall lighting. A 42-circuit load-breaker lighting panel mounted in the under-stage vault provides overcurrent protection for the numerous underground circuits. Space is also provided for metering

SHELTER AREA at north end of the long block features 100-watt decorative hanging-type lanterns, public telephone and weatherproof receptacles. Arrow points out handhole which provides branch circuiting to the area.

LARGE EVERGREEN TREE in grass area at south end of mall is highlighted after dark by two PAR-56 weatherproof 300-watt colored floodlights (arrows).

PHOTOS SHOW side and rear views of sub-distribution cabinet feeding "short" block of mall. Notice in side view how the steel cabinet is hidden from sight by masonry and foliage. Also note garden type light fixture (arrow). The outdoor lighting unit is typical of many used throughout the mall to highlight greenery and flowers. Front view illustrates how distribution cabinet is concealed by tile-pipe grill (arrow). Fountain in foreground is illuminated by double underwater floods with rotating color wheels.

equipment, the machinery for the rotating stage, a time clock, and a relay which is connected to the photo-electrically controlled street lighting system.

Sub- and branch-circuit distribution for both blocks of the mall are carried out in exactly the same manner. But it might be well to discuss briefly the various types of lighting equipment used to highlight the features of the longer section of the mall. First of all, a shelter located at the north end of the block is illuminated by four 100-watt decorative hanging-type lanterns. A number of weatherproof receptacles hidden in shrubbery at the front of the shelter will be used for Christmas lighting purposes and various other displays. Large sections of grass areas are planted with flower gardens, low evergreens and shrubbery—all of which are accented by numerous forms of garden lighting equipment and colored outdoor floodlights. In the middle of the block a large stage featuring a 12-ft revolving center is floodlighted by a group of four weatherproof 300-watt PAR-56 floods, bar-mounted to the top of a street lighting standard adjacent to the front-center of the stage. Four weatherproof receptacles and telephone outlets installed on four corners of the eight-sided stage will provide power for all types of equipment (including video sound) when the stage is used for special displays and exhibits. A blocked-I shaped pool with fountains at both ends that are illuminated by double underwater floodlights with rotating color wheels provide a continuous show of color after dark. Colored PAR-56 floodlights are also used as up-lights to accent trees.

This step which Kalamazoo has taken is not a temporary trial-measure; it is a permanent project directed toward carrying out a long range plan, but giving immediate results.

TYPICAL EXAMPLE of how weatherproof FS type boxes with duplex receptacles (arrow) are installed throughout the mall. Units will be used for various displays and for Christmas decorations. Wiring is fed to this receptacle from a handhole set flush in a colored concrete block.

REMODELED APARTMENT BUILDING brings a "new look" to Chicago's "Old Town" (a near-north side residential district). Although the apartments present a colonial atmosphere —they are completely modern. Each of the 16 rental units is heated and cooled electrically. Other electrical facilities include electric fireplaces, kitchen and bathroom ventilating fans, built-in electric cooking units, and electric water heaters. Old building offering contrast at right (arrow) will soon be added to the remodeled project.

All-Electric Colonial Style

Renovated apartment building combines the comforts and conveniences of all-electric living with the styling and architectural design of an early American setting.

SPACE-AGE comfort in a picturesque colonial setting is the rare combination in store for tenants of Williamsburg Gardens, a renovated apartment building on Chicago's near north side in a section of the city known as "Old Town."

The project of Old Town Restoration Ltd. features 16 all-electric units that are a combination of duplex, patio and studio apartments. The modern, up-to-date units have materialized within a brick shell that until recently enclosed four ancient buildings. Only the outer walls of the old structure were retained. Houston-Warren, builders in charge of the modernization project brought about the colonial setting by refacing the exterior walls of the old building with "Redi-brick," Williamsburg-styled with gables, and by adding shutters and wrought iron balconies. Inside the gutted structure they fitted eight duplex apartments plus eight smaller units.

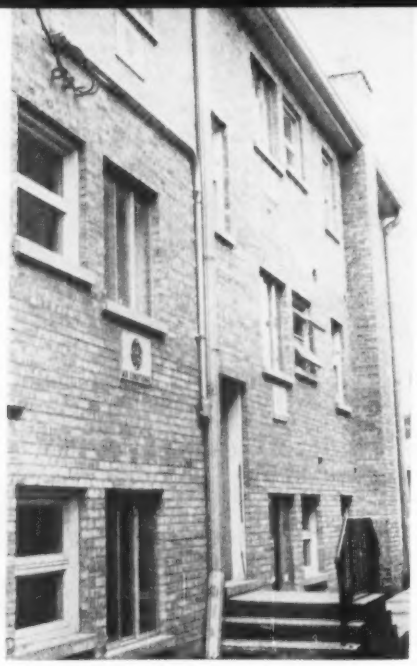
Each of the apartments is heated and cooled electrically. Heating is provided by radiant baseboard units strategically placed to provide complete comfort at all times. Tenants choose their own level of electric heating by thermostats installed in each room. Summer air conditioning comfort is supplied from 1-ton, 240-volt air conditioners installed through the wall under windows in each apartment's living room. Provisions have also been made (should tenants request it) for installation of additional air conditioners in any or all bedrooms.

Other electrical conveniences included in the all-electric apartments are copper-hooded mosaic tiled electric fireplaces, bathroom ceiling exhaust fans, kitchen assemblies of built-in oven and range units, refrigerators, water heaters and hood fans mounted over the built-in ranges. Electrical systems powering the 16 apartments are tailored to meet 100-Plus Medallion specifications. Each rental unit has a 100 amp-built-in circuit breaker panel to control its numerous electrical servants. The apartments are metered separately and tenants pay their own electric bills. The electrical contractor responsible for the overall installation was B & A Electric Construction Co., Chicago.

Another innovation whose design dates back to another era but was installed with futuristic planning is this: All the apartment's living rooms overlook a rear courtyard that features a landscaped garden with a fountain, plus concrete walks. These walks through the garden plus all approaches to the apartments have been "snow-proofed" by installing electric heating cables beneath their concrete paving.

YEAR-ROUND COMFORT in the Williamsburg Garden apartments is furnished by a combination of electric baseboard heating units and 1-ton room air conditioners. Tenants select their own level of electric heating on thermostats installed in each room.

FLUSH-MOUNTED 100-AMP LOAD CENTERS are installed in each of the 16 apartments. In the 2-bedroom duplex units the 100-amp distribution centers furnish 13 120-volt single pole circuits, one 3-wire heavy-duty kitchen appliance circuit, plus 240-volt feeds for counter top range and oven, water heater and air conditioner. Shown inspecting a typical panel's circuiting are (L to R) George Cuonzo, Electric Heat Specialist, Commonwealth Edison Co., and Ray Roegiest, Construction Superintendent.



EXTERIOR-MOUNTED service entrance conduit is installed at the rear of the apartment building. The conduit, weatherhead entrance elbow and holding straps are all aluminum. This is reportedly the first aluminum conduit service installation in the city of Evanston.

Power-Plus Apartment Wiring

Contractor sold owner wiring job—not price—by citing the advantages of installing an electrical system planned to meet apartment dwellers' increasing demands for more electrical servants.

By W. J. Martens

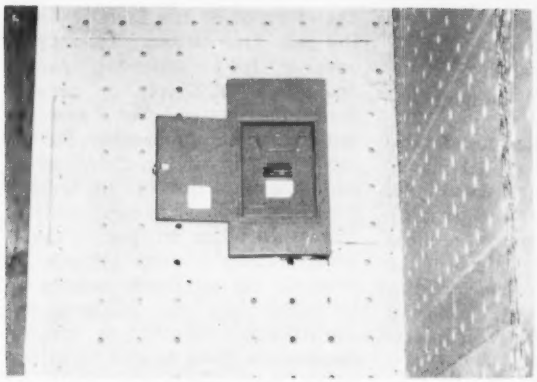
TENANTS renting space in Hye Builders new 6-unit "walk-up" located in Evanston, Ill., will find built-in electric cooking equipment, kitchen hood fans, garbage disposals, modern lighting treatments, and numerous electrical outlets with sufficient electrical capacity to back them, plus provisions for partial or total air conditioning.

It might be well to point out here that past surveys have indicated that apartment dwellers want the same beauty and conveniences that they have seen and read about in private homes. And what's more, when it comes down to the question of dollars and cents they are willing to pay for these attributes. Meaning that the owner of this building, Arthur Mardirosian, is cashing in on the tremendous opportunities for landlords to provide apartment features that lead to increased rental rates and greater tenant stability. But Mardirosian isn't entirely responsible for the high-capacity wiring job installed in his most recently completed apartment house. A great deal of the credit must go to the electrical contractor who planned and then sold the job. Although Skitch Electric Company of Elmwood Park, Ill., entered a bid that was almost $1,000 higher than their nearest competitor, they were awarded the job. You might ask how this was possible. It's really simple; A. J. Smith, president of Skitch Electric, firmly believes in selling wiring up. After learning that his bid was higher than the others submitted, he arranged a meeting with the building owner. During the course of this meeting Smith pointed out in detail why the wiring system he planned would be to the owners benefit.

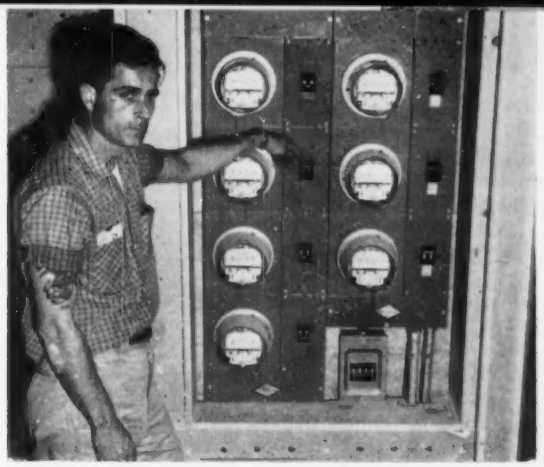
Some of these details have already been cited. Here are a few of the others: (1) Smith promised that the materials used on the project would be of an established quality—or better. For example, silent type switches would be used throughout the apartment; all devices would be ivory; receptacles in the kitchen-dinettes, utility and bathrooms would be a groundable type with chrome-finished plates. (2) Overcurrent protection for each of the six rental units would be provided by non-interchangeable, color-coded circuit breakers. (3) Clock chimes located in each apartment would have individual transformers—meaning there would be little or no voltage drop to cause inefficient operation of these units. (4) The exterior-mounted service entrance conduit and fittings would be aluminum. (This is reportedly the first installation of an aluminum conduit service in the city of Evanston.)

Next Smith spelled out the basic wiring methods his men would employ to accomplish the job. The following are two of the more important methods defined by Smith: (1) Branch circuit runs carried in EMT would not be installed beneath the apartment's wooden floors (generally considered a standard practice); rather, the runs would be looped between outlets by installing them in the walls, near the floor, behind plaster grounds. Although this perimeter method requires a little more material, especially wire, it lessens the amount of labor needed to pull in circuit wires; also it reduces the possibility of squeaky floors sometimes attributed to the underfloor method. (2) All low-voltage wiring (operating heating thermostats, vestibule door openers and annunciators, plus built-in clock chimes) would be enclosed in an EMT raceway—permitting easy replacement should fault occur in future years.

And last, but not least, Smith stressed the need for his planned power-plus distribution system. He called the owner's attention to the fact that modern design requires that service entrance and distribution components provide for a margin of capacity in excess



THE MAIN DISCONNECTING MEANS for the service is a flush-mounted, dead front, pull-out type entrance switch. The 200-amp, 110/220-volt, 3-wire, single-phase switch is built into the wall directly alongside the rear entrance.



CONTRACTOR A. J. Smith, president of Skitch Electric, is pictured at the apartment's main distribution and metering center. Power for each of the six apartments is metered separately and controlled by 70-amp main breakers.

of immediate load requirement (1) to permit load growth; (2) to permit operation below maximum capacity under all conditions. Since the aim of the owner's overall construction design was to combine the latest improvement in construction methods, equipment, and materials to make the building more attractive, more comfortable, and more safe than the average apartment, he was an ardent listener.

The result of Smith's meeting with the building owner you already know. Now let's see how Skitch Electric's functional system design provides for modern residential utilization in the 6-unit apartment. We'll begin with the 200-amp service entrance installed on the exterior rear wall of the apartment. Although 200 amps for main service was the absolute minimum set forth in Skitch Electric's proposal, it was considered more than capable of handling the planned electrical load.

A 200-amp, dead front, main pull-out switch is flush mounted where the service conduit enters the building alongside the rear entrance door. A 2-in. conduit (aluminum) runs concealed inside the rear wall from the bottom of the 200-amp main switch. When the conduit reaches the ground level of the apartment it is elbowed; from this point it proceeds horizontally beneath the concrete floor to its termination point in the building's metering and main distribution center. To prevent possible corrosive action from taking place, the section of 2-in. aluminum conduit installed beneath the floor was coated with a covering of asphalt paint.

The 4-ft by 3-ft main distribution and metering panelboard contains individual meters for each of the six apartments (tenants pay their own electric bills) and a house meter for public lighting and other building services. 70-amp main breakers for each of the apartments are located directly opposite their corresponding meters. The vertical trough-mounted meters and main breakers are ganged in a recessed opening built into the wall between

ELECTRICALLY POWERED KITCHENS were possible because of the well-planned, high-capacity wiring job. The apartments' kitchen-dinette areas and adjoining utility rooms are served by three 20-amp, 110-volt appliance circuits. Also, as seen by these photos, each apartment has an electric counter-top range unit, electric wall-mounted oven, hood fan, clock chime, recessed light over the sink, and a vestibule door opener and annunciator unit. Not in view is a pull-down fixture over the dinette area and a garbage disposal unit below the sink. Arrow on extreme right above points to a 15-amp, 220-volt outlet for a through-the-wall air conditioner. Convenience outlets are grounding type.

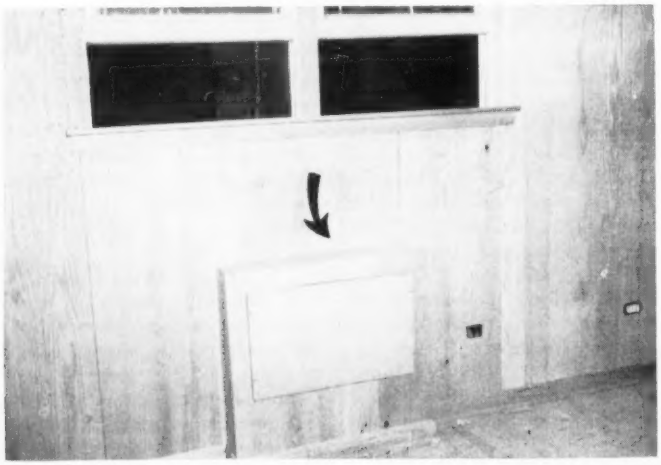
the two ground floor apartments. And, in order to provide the distribution center with a finished look, the owner enclosed it with a hinged, framed glass door.

1-in. EMT feeders are run from the six 70-amp main breakers to each apartment's multi-breaker distribution center. The multi-breaker panels are of the non-interchangeable type—meaning it will be difficult, if not impossible, for tenants to tamper with the breakers. A feature of the panels that is to the advantage of the tenants, and should be mentioned at this time, is color coded circuit breakers. The manufacturer of the panels, by providing colored handles on the breakers, enables the tenants to easily distinguish each breaker's amperage classification.

The 16-circuit panelboards are flush-mounted in the apartments' utility rooms, which are located next to the kitchen-dinette areas. By installing the panelboards in these locations, the lengths of three of the five 220-volt, dp branch circuits plus four of the six 110-volt sp branch circuit runs in every apartment were minimized.

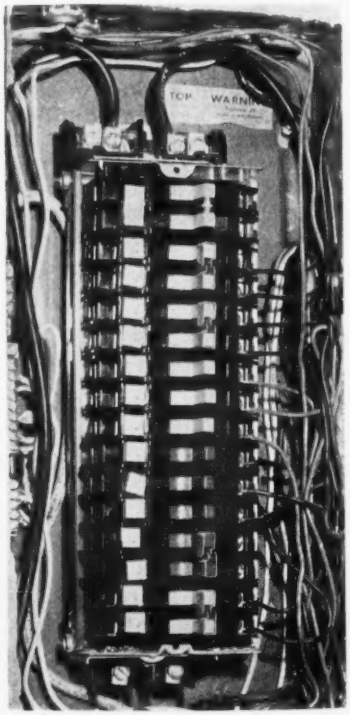
The following circuit schedule for a typical apartment best tells the story of Skitch Electric's wiring job: One 30-amp, 220-volt, dp breaker for counter-top range; one 20-amp, 220-volt, dp breaker for wall-mounted oven; one 15-amp, 220-volt, dp breaker for air conditioner in kitchen-dinette area; one 20-amp, 220-volt, dp breaker for air conditioner in each bedroom (two bedrooms to every apartment); three 20-amp, 110-volt, sp breakers for appliance circuits in kitchen-dinette and utility room; one 15-amp, 110-volt, sp breaker for heating plant located in utility room; two 15-amp, 110-volt, sp breakers for general lighting circuits.

In conclusion, it can be safely stated that Skitch Electric Company, through proper planning and by employing improved wiring techniques and modern materials, helped the apartment owner to accomplish his goal—to make the apartment not only more comfortable and attractive, but also an easier, safer place for his tenants to live.



PROVISIONS FOR AIR CONDITIONING are provided in all the apartment's bedrooms and kitchen-dinette areas. Framed out spaces (arrow) beneath windows are built to receive ¾ ton air conditioners (furnished by tenants). Unfinished outlet at the right that will power air conditioner is served by a separate 15-amp, 220-volt circuit.

EXTERIOR FRONT VIEW of the 6-unit apartment building is a good example of the type of modern design employed by the builder throughout the entire apartment. The wiring job planned and sold by Skitch Electric played an important role in this design. The post light installed in front of the apartment's main entrance is a good illustration of this fact.



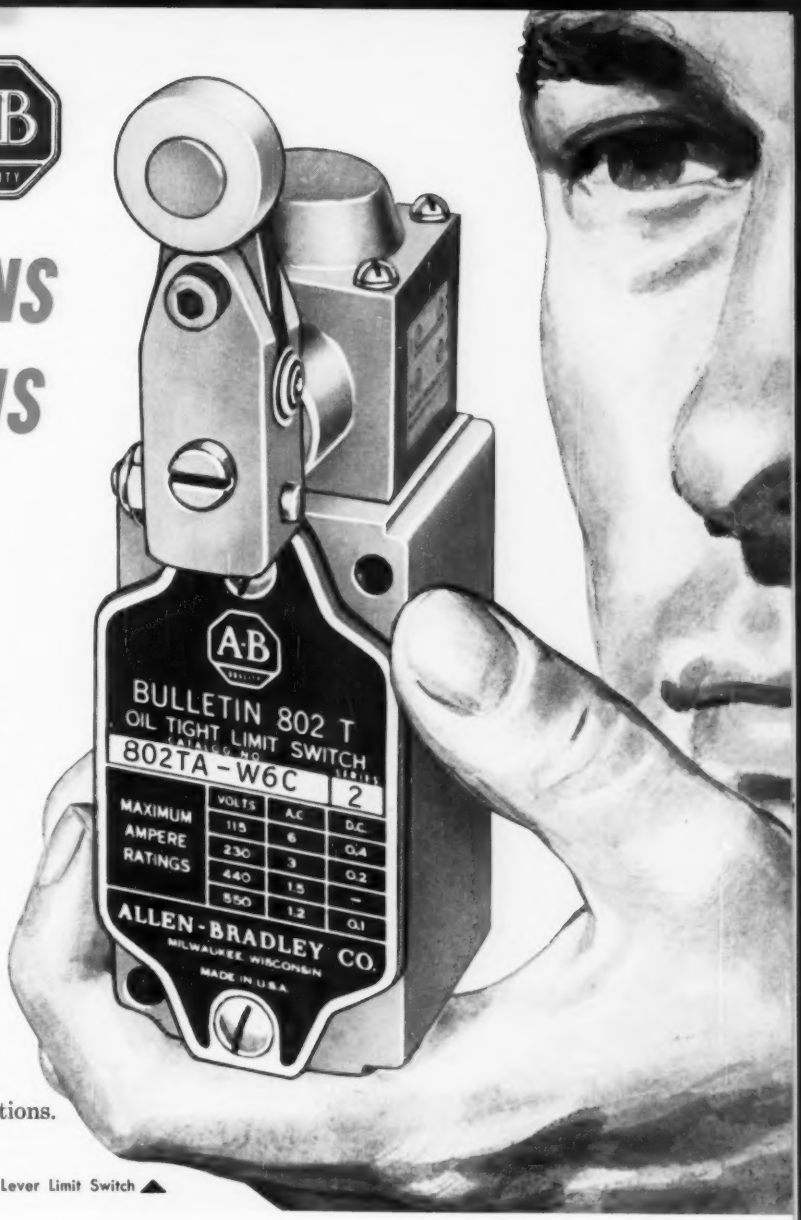
FLUSH-MOUNTED, 16-circuit, color coded, non-interchangeable circuit breaker panel shown here is typical of those units installed in the utility room of each of the six apartments. The breakers are painted various colors to help the tenants recognize each breaker's amperage classification.

MORE MILLIONS OF OPERATIONS

with Allen-Bradley Limit Switches

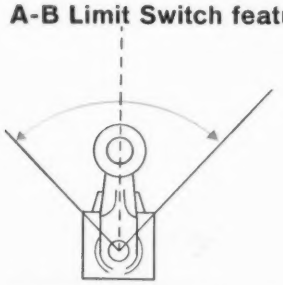
There's nothing now on the market to match the reliability and trouble free performance of Allen-Bradley Bulletin 802T limit switches. They are completely oiltight—operating heads and switch bodies are sealed against oils, coolants, and metal chips. Operators cannot become sluggish or "stick" in operation—contacts cannot become fouled. The double break, silver contacts are always in perfect operating condition—and remain so without maintenance.

Insist on Allen-Bradley—the *quality* line of limit switches that will give you *many more millions* of trouble free operations.



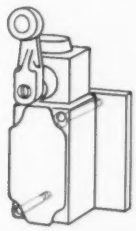
Bulletin 802T Micrometer Adjustment Roller Lever Limit Switch ▲

A-B Limit Switch features mean more life, more dependable trouble free service

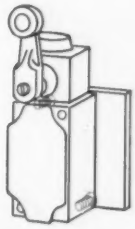


REPETITIVE ACCURACY—Unique toggle blade action assures operation at precisely the same point each time, without adjustment.

FLEXIBILITY—All operating heads can be rotated and fastened in any of four positions 90° apart.



FRONT MOUNTING



REAR MOUNTING

All Allen-Bradley Limit Switches can be mounted either from the front . . . or from the rear.

SEE OTHER SIDE FOR TYPICAL APPLICATIONS ⟶

1-60-MR

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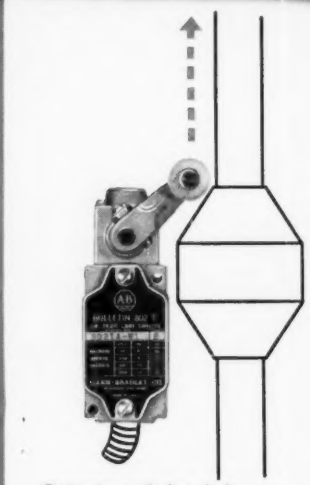
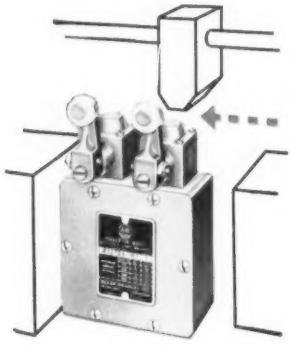
QUALITY MOTOR CONTROL

Allen-Bradley has an Oiltight Limit Switch to meet your exact needs!

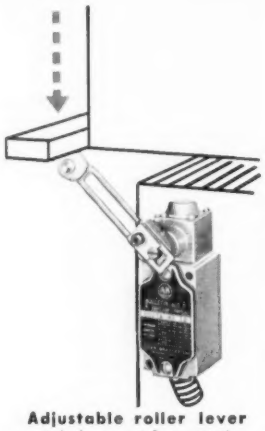
From among the wide variety of Allen-Bradley oiltight limit switches, you are certain to find the exact type to satisfy your specific requirements. If you do not, then please discuss *your* problem with us. A-B limit switches are available with many different levers, lever-contact actions, operating forces, and actuator motions—in spring return or maintained contact construction. A new 16-page illustrated booklet on this *quality* line of A-B oiltight limit switches is just off the press. Write for it!



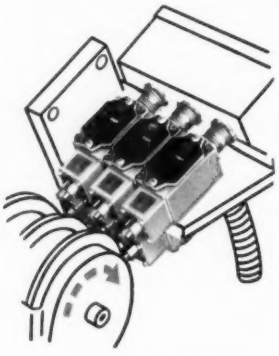
Roller lever limit switch—Here it is operated by dog on vertically moving shaft.



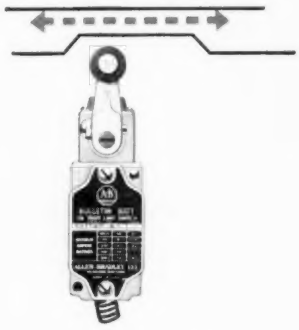
Duplex limit switch where block can also trip second switch for safety insurance.



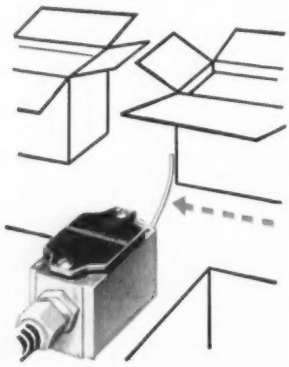
Adjustable roller lever switch. Lever set for operation at greater than normal distance.



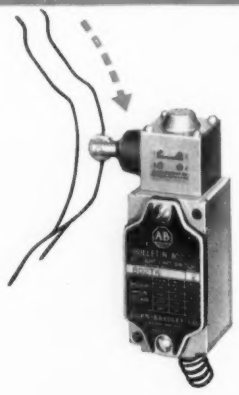
Top push roller limit switches are frequently operated by rotating cams on machine tools.



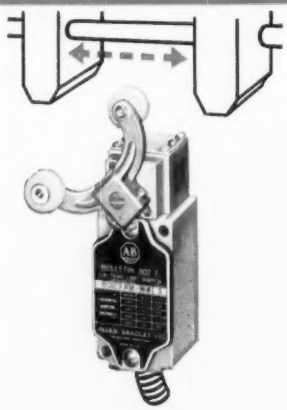
Neutral position switch—moving bar closes separate contacts as it moves each way.



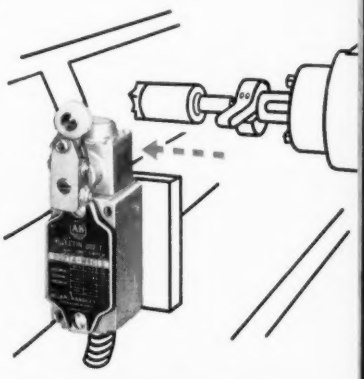
Cat's whisker limit switch is actuated by movement of lightweight units on conveyor.



Side roller limit switch, as illustrated here, is being actuated by a rotating cam.



Fork lever maintained contact switch—adjustable dogs trip one roller in each direction.



Micrometer adjustment switch for precise setting of trip point in machine tool operations.

1-60-MR

ALLEN-BRADLEY

QUALITY MOTOR CONTROL

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In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

LUMINOUS CEILING, suspended beneath both old and new sections of assembly plant, hides dissimilarities of construction and fixtures while unifying entire area into high-intensity low brightness environment for accurate completion of small-detail work related to electronic components. Desk-level intensities of 80 fc are obtained with 4w/sf load, using dual-lamp channels equipped with 8-ft T-12s.

Relighting an Industrial Assembly Plant

LIGHTING

The phrase "business as usual" is rarely as literally applied as it was when Lenkurt Electric Co. recently expanded and relighted their electronic industrial assembly plant in San Carlos, Calif. In that instance, normal operations were maintained in an original 45,000-sq-ft building while structural additions were erected on all sides to completely surround and double the area of the older structure. After lighting had been installed in the new section, operations were shifted from the old central core (during normal down-time) so that no interruptions in work schedules resulted. Then the original section of the plant was relighted to visually coincide with the new construction. And, to complete the expansion and modernization program, the original structure was repainted and refurnished to blend with the new peripheral additions.

The lighting plan was dictated strictly by practical rather than aesthetic objectives, for it was essential that critical seeing tasks related to assembling small components and examining small details should have high-intensity low-brightness shadowless illumination. These objectives suggested a wall-to-wall luminous ceiling with maintained footcandle levels on work surfaces in the order of 80 fc. The result, as the accompanying photograph indicates, is an installation that achieves aesthetics in spite of itself, and a lighting job that is more generally associated with commercial rather than industrial interiors.

As can be noted in the "in progress" photo, structural details and lighting fixtures located above the corrugated plastic panels vary considerably, although these dissimilarities are completely hidden from view by the suspended ceiling. As shown, the typical 2-lamp industrial fixtures in the older structure were reused, although they were raised and shifted in several instances, and the resulting lighting pattern was "smoothed out" by adding additional double lamp strips where required. These same double lamp strips, equipped with cool-white 8-ft T-12s, were likewise used in the new additions.

Total lighting load in this 2-acre installation is 304 kw. And, reflecting commendable forethought in the interest of maintaining light output at a high level, a washing machine dimensioned to receive the corrugated plastic panels was purchased at the time of the installation.

Planning and installation was a cooperative effort by the contractor, Biber Electric of San Carlos, the engineering department of the owner, and the local representative for Sylvania Electric Products.

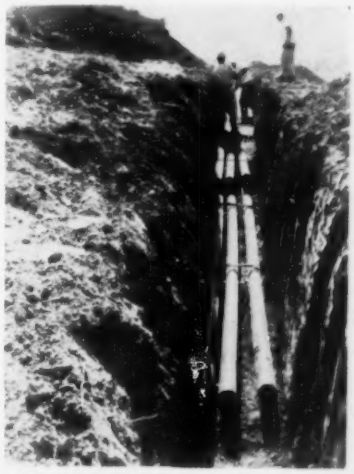
While the objectives were primarily for "good visibility for detailed assembly work," other obtained results have included less spoilage of product, fewer rejects, increased output, higher employee morale and an impressive improvement in appearance.

Plastic Conduit for Underground Feeders

INSTALLATION

Approximately 30,000 ft of 5-in. plastic conduit has been used for underground electrical installations serving three new buildings on the campus of the University of West Virginia at Morgantown. Produced by Franklin Plastics, Inc., Franklin, Pa., the conduit was installed in 30-ft lengths with all joints completely waterproofed by use of a plastic compound. The compound is a solvent which forms a homogenous bond when it solidifies at the joints.

Impervious to moisture and soil acids, the plastic conduit has a smooth interior surface which permitted ready "fishing" of wires with little friction or abrasion. Being flexible, the conduit was assembled on top of the ground and then lowered into the excavation, with long radius bends possible without elbows or deflector couplings.



PLASTIC CONDUIT for underground electrical distribution is shown here in trench prior to pouring of concrete envelope.

T. D. McClure, Jr., electrical contractor of Atlanta, Ga., doing the electrical work on the buildings for the Schools of Engineering and Agriculture, said this conduit was installed in less than half the time normally required for other types of ducts weighing about ⅛ that of metal conduit, the pipe was handled easily in 30-ft lengths instead of conventional 10-ft sections by McClure workmen, thus eliminating two-thirds of the joints required. Ability to fabricate long lengths of the plastic conduit on the ground, and lowering it into the excavation for encasement in concrete, was another important time-saver on the job.

Generating Plants Power TV Booster Station

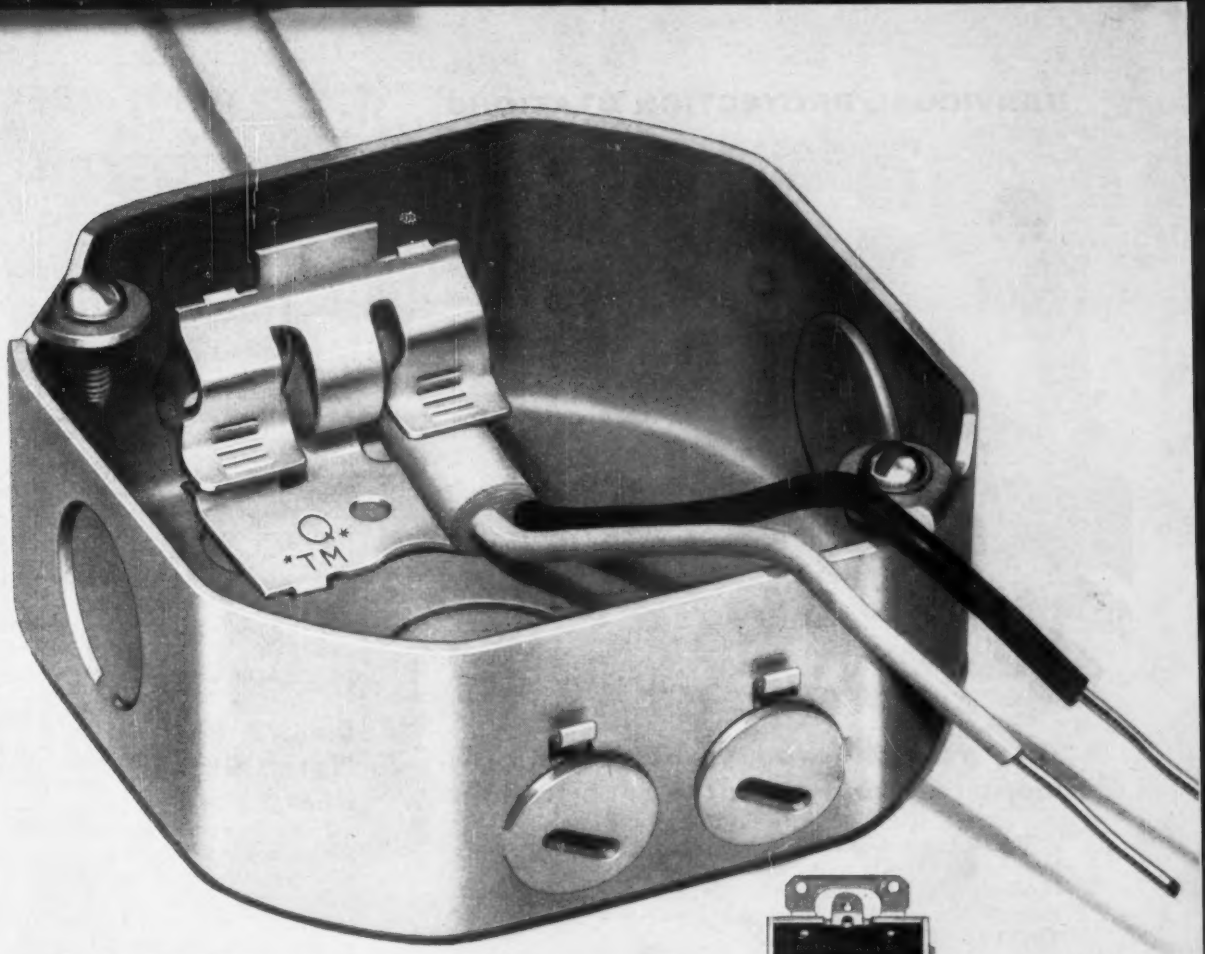
EQUIPMENT

Two diesel generators—one running continuously, the other a standby—provide self-sustaining power for a television booster station serving Booneville, a sheep-raising and logging community in California.

Dissatisfied with the unsatisfactory, sometimes non-existent picture received, the people of Booneville started a fund-raising drive for the purpose of constructing a booster station on nearby 2000-ft-high Grizzly Peak which would convert VHF beams to UHF.

The cost of running commercial power lines to the mountaintop was prohibitive. The two 3-kw, 60-cycle, 115-volt generating sets provided a logical solution to the problem, although 20 miles of twisting, rutted logging roads up the mountain must be negotiated by truck or jeep to service the units. Every week or

BOOSTER STATION atop 2000-ft mountain retransmits TV signals to residents of Booneville, Calif. White circle shows red signal light visible from the town two miles away, which when lighted indicates that generating plant is operating.

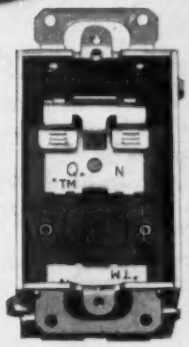


RACO screwless "Q*" Quick-Clamp saves time on the job

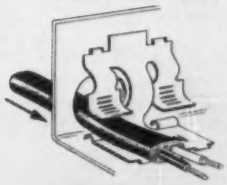
With RACO's new "Q" Quick-Clamp you can install non-metallic sheathed cable in seconds—without clamp screws. Simply push the cable through "Q" Quick-Clamp. Cable is held firmly in place, can't be pulled out until clamp is released. To release the cable, apply a little pressure under the clamp with your screwdriver. With the new "Q" Quick-Clamp there will be no more lost time tightening and loosening cable clamp screws... no more stripped screw heads.

And... you'll save an hour or more on the average job (60 to 100 boxes per house). Your RACO Distributor has the new "Q" Quick-Clamp Switch and Outlet Boxes. (Exceed Underwriter Laboratories' tests; are fully protected by patents.) See them and try them now.

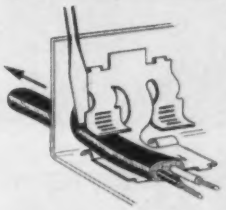
*Trademark



"Q" Quick-Clamp available in RACO switch or outlet boxes

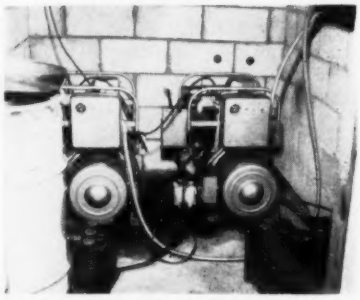


Cable moves freely into clamp and is gripped tightly



To back-off cable, release clamp pressure with screwdriver

RACO **ALL-STEEL EQUIPMENT INC.** Aurora, Illinois



DIESEL ELECTRIC plants inside mountaintop shelter each provide 3000 watts at 60 cycles, 110 volts. One serves as standby.

ten days a volunteer makes the trip to check operation and alternate the load from one unit to the other.

The installation includes a line transfer control which stops the operating unit and switches the load to the standby in case of overspeed, high or low voltage, low oil pressure, or high air temperature.

Electric Heat Warms Dugout

HEATING

Radiant panels have been installed in the White Sox dugout at Comiskey Park, Chicago. The new Arvin panel incorporates a printed aluminum foil circuit laminated to a vinyl facing. Current through the foil warms the vinyl to approximately 170 degrees F. Rigidity is achieved by laminating the vinyl and aluminum foil to a sheet of steel backed by fiber glass insulation. Rated at 500 watts, 120 volts, the panels measure approximately 2 by 4 ft, ½ in. thick.

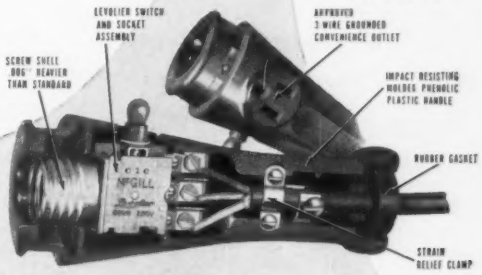
Bolted flush against the ceiling of the dugout, the panels direct heat onto the players' backs and shoulders and help to prevent muscles from tightening up between innings on cool spring and fall days.

WHITE SOX MANAGER Al Lopez tests electric heating panels installed on ceiling at dugout at Comiskey Park. Players can warm their hands quickly on snappy days by holding them directly against the vinyl-covered panels.

McGILL® PORTABLE LAMP GUARDS are always a little better ...and all are UL inspected

- Rugged, steel wire cage. Spot-welded with extra heavy zinc plated, chromate finish.
- Tough, gray molded phenolic handle resists impact, heat oils, greases, some acids, moisture and abrasion.
- Concentrating end lens. • Convenience hook.
- Approved 3-wire grounded convenience outlet.
- Exclusive McGill LEVOLIER Switch. • Rotary reflector.

No. 5000 SLRG



An extra margin of quality is designed and built into the complete line of McGILL industrial portable lamp guards for safe, dependable utility. Rugged, heavy duty construction and selected materials withstand the punishment of rough use. The famous McGILL LEVOLIER switch mechanism provides a degree of dependability not found in ordinary portables. It's economical to specify the best.

More than 100 different types of McGILL portable lamp guards have been developed to meet the particular requirements of a wide range of service conditions. Cages 50 to 200 watt. 660 watt, 250 volt sockets.

For detailed descriptions of the McGILL line of top quality electrial specialties, including portable lamp guards, and Levolier switches write for McGILL ELECTRICAL SPECIALTIES CATALOG No. 84.

No. 7100 SR Lamp Guard

Thumb clamp arrangement for cage to change lamps quickly without tools. Gray Neoprene-butyl handle; reflector; LEVOLIER switch.

No. 5025 SRG Service Light

Completely grounded service light. 15 amp., 125 volt convenience outlet built into molded phenolic handle. Safe on-the job source for power tools. Levolier switch and 25 ft. 16-3-SJ gray rubber cord.

No. 5000 SR Lamp Guard

With 15 amp., 125 volt convenience outlet in impact and heat and grease-resisting positively insulating molded phenolic handle. No-Rol cage, Levolier switch and reflector.

No. 3006 Vaporproof Lamp Guard

Watertight, vaporproof and moistureproof for complete safety. Heat and impact resisting glass globe screws into a silicone rubber gasket. Handle molded of macerated phenolic.

No. 652 Lamp Guard

Rubber hook handle, thumb release clamp for easy bulb replacement. Can be hung, for maximum light, from hook or handle.

Write for Free McGill Catalog No. 84

engineered electrical products

McGILL®

precision needle roller bearings

McGILL MANUFACTURING COMPANY, INC., ELECTRICAL DIV., 450 N. CAMPBELL ST., VALPARAISO, INDIANA

Shop-made Dolly Carries 14 Wire Reels

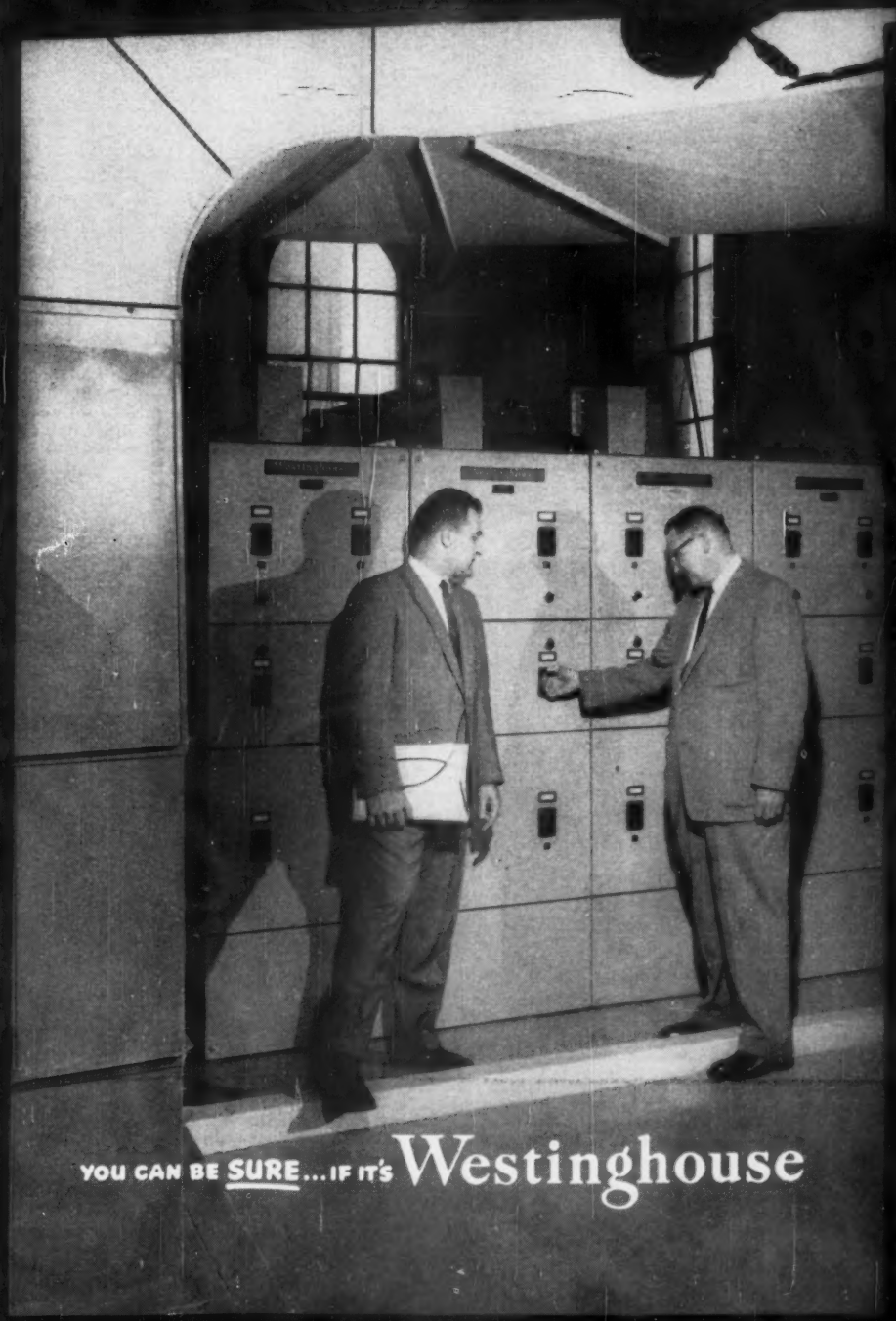
EQUIPMENT

By dimensioning a wire-reel dolly intelligently, Stetson Electric Co. of Los Angeles can compactly carry six standard disposable spools between angle framing designed to easily pass through a normal doorway. Or, where construction projects do not have to consider lateral clearances of passageways, outrigger conduits can be inserted between reels and across both ends of the dolly to support eight more (four on each side) reels. On large projects where branch wiring is extensive, this large-capacity wire-carrying rig is a labor- and time-saving device, providing journeymen with an ample supply of wire in a convenient package.

As indicated, the basic framework of the dolly is formed from welded sections of lipped channels. Spindles, supporting reels between side framing members, are prevented from shifting laterally by capped sockets, while sockets and auxiliary brackets for longer overhanging conduit spindles are bolted to the framework. Wheels are rubber-tired to prevent marring of floors or tiling in commercial areas, and front wheels are castored to permit easy rotation and movement direction.

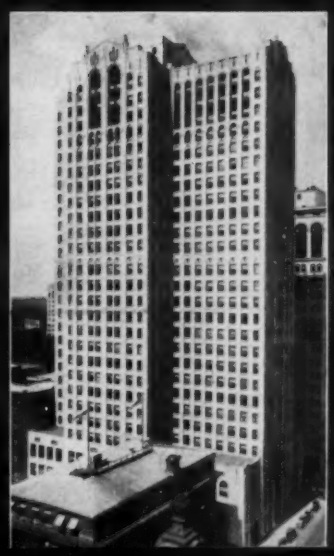
Electricians stand at the front end of the dolly on either side when they are feeding wire from the reels, and little slack is needed.

ALLOWING SUFFICIENT CLEARANCE between wire reels on upper tier of dolly makes it possible to place auxiliary conduit spindles in brackets provided for that purpose. When unusually large supply of wire is desirable for branch circuiting purposes, these auxiliary overhanging spindles can carry an additional four reels on either side of the rubber-tired rig.



YOU CAN BE SURE... IF IT'S Westinghouse

Contractor planning minimizes electrical modernization costs



COVER PHOTO: William F. Lorenz, W. D. Gale, Inc., Electrical Contractors; and H. C. McDaniel, Branch Manager, WESCO, Detroit, examine new Westinghouse building-type switchboard which is used to protect and distribute power to upper floors of Buhl Building. Size and weight of equipment placed in this room had primary importance. Installation was made without enlarging doorway shown. COVER INSET: Buhl Building, Detroit, Mich., built in 1925, has long been one of the city's preferred business locations. Electrical modernization, completed in 1958, assures the building's continued "Class A" rating with adequate electrical facilities for many years to come.

M. E. Tisdale, Westinghouse Sales Engineer; Ralph E. Thomas; and William F. Lorenz check two banks of single-phase, 4800-volt Westinghouse dry-type transformers for operating audibility. (Three 100-kva units, and three 167-kva units with top connections housing the low-voltage leads.)

Close-up of building-type switchboard shows AB De-ion® type molded case feeder breakers. In background, Ralph E. Thomas; James E. Miller, Westinghouse Construction Sales Engineer; and William F. Lorenz are shown with three 100-kva DS-3 dry-type transformers. Westinghouse dry-type transformers were specified because of their smaller size and lighter weight. (Structural load had to be considered, as this converted rooftop room was not originally designed for equipment.)

William F. Lorenz, M. E. Tisdale and Ralph E. Thomas (who, in addition to being Building Manager, is a registered professional electrical engineer), discuss the electrical plans which resulted in maximum modernization of Buhl Building at minimum cost and inconvenience.

J-94131-2

Buhl Building modernizes to Build Business Electrically for next 20 years' growth

Plans for the electrical modernization of the Buhl Building in Detroit began with an analysis of the present electrical needs of the building and its tenants and a careful estimate of its possible requirements for the next 20 years.

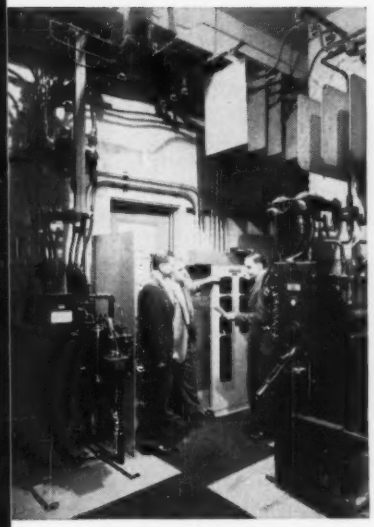
The Building Manager, Ralph E. Thomas, worked closely with William F. Lorenz, Engineering Representative of the Electrical Contractor, W. D. Gale, Inc., Detroit, in preplanning the electrical system. It was decided to double the capacity by retaining the existing system to supply power to the lower half of the building. A new source for power distribution would then be installed on the roof of the building to supply the upper floors.

Westinghouse electrical equipment was specified for the installation, since special considerations of size, weight and quietness had to be satisfied. Included in this equipment was a Westinghouse building-type switchboard and Westinghouse DS-3 dry-type transformers. These were moved to the roof by the building's regular service elevator and installed in an existing room there. It was not necessary to enlarge any doorways or break through any walls. The minimum weight of the Westinghouse equipment permitted installation without structural reinforcement. In addition, the dry-type transformers were proved to be completely noiseless and vibrationless.

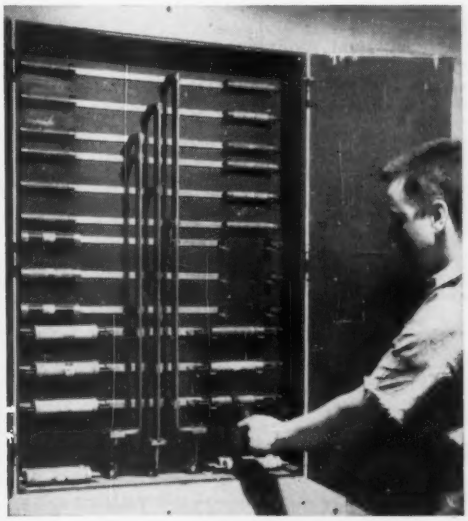
Important to both the contractor and the building management were the savings realized by this ease of installation. Final costs proved

(*continued*)

J-94131-3



The primary oil circuit breaker arrangement shown will insure a power supply to building tenants under any fault conditions. M. E. Tisdale, William F. Lorenz and James E. Miller are in front of oil circuit breaker relay panel.



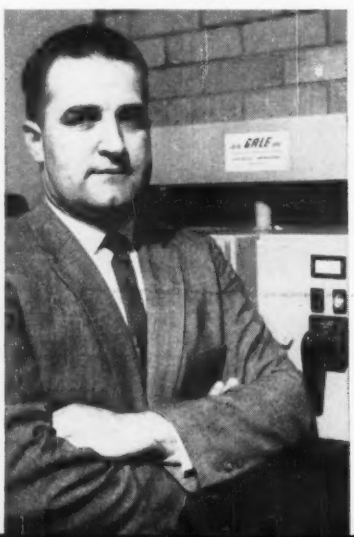
New Westinghouse Type FDP, completely safety protected combination switch and fuse panelboard, at right, has replaced the older, unsafe, live-front panelboard shown at left. This new panel not only safely protects all fuses and bussing, but the quick-make and quick-break switches provide positive opening and closing of the circuits.

William F. Lorenz points out to Ralph E. Thomas and H. C. McDaniel the key interlock in handle of one of three Type LCB air disconnect switches. With these switches, transfer can be made from primary lines to insure constant power supply to lighting and power transformers in new electrical equipment room. The Westinghouse DS-3 single-phase dry-type transformers shown in rear each feed a section of the building-type switchboard.

Buhl Building modernizes to Build Business Electrically for next 20 years' growth *(continued)*

The new pump and Westinghouse 50-hp Life-Line® motor keep the water reservoirs automatically filled on the various floors of the building. This new single pumping unit can perform more efficiently than the two pumps and 50-hp motors previously used.

William F. Lorenz of W. D. Gale, Inc., Electrical Contractors, holds degrees in both Civil and Electrical Engineering. His knowledge of currently available electrical equipment, and engineered preplanning, together with the skill of his firm's personnel in actual installation procedures were major factors in the economical and efficient electrical modernization of Buhl Building.



less than those estimated by both the contractor and management.

Westinghouse can help you in solving your modernization or new construction problems . . . to Build Business Electrically.

See the Westinghouse distribution outlet nearest you or write Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pennsylvania.

OWNER: Buhl Land Co., Detroit, Mich.

ELECTRICAL CONTRACTOR:
W. D. Gale, Inc., (Members of Detroit Chapter, NECA), Detroit, Mich.

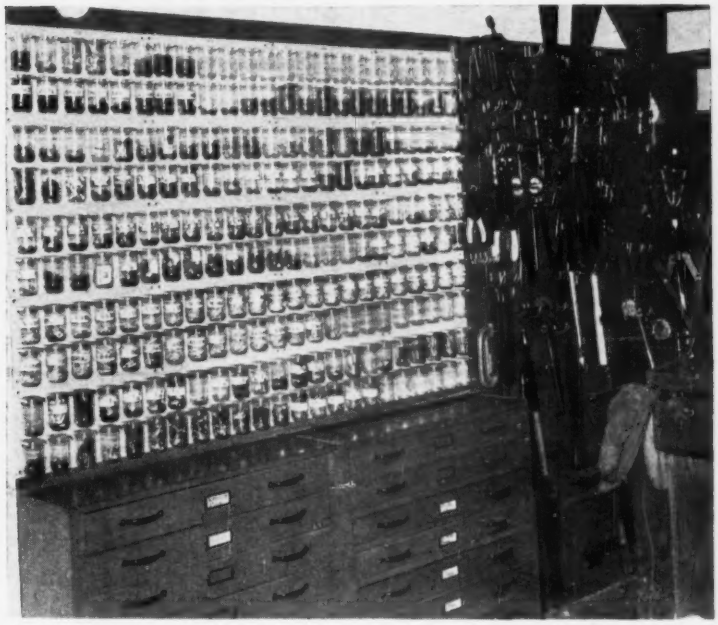
WESTINGHOUSE DISTRIBUTOR:
Westinghouse Electric Supply Co., Detroit, Mich.

YOU CAN BE **SURE**... IF IT'S

Westinghouse

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS CBS TV ALTERNATE FRIDAYS

J-94131-4



COMPACT WALL RACK holds 230 jars for storing variety of small replacement parts and repair accessories; combines access ease with quick visual identification and comparison.

Slide Clips Hold Parts Jars

Good housekeeping practices lead to efficient shop operation. And efficiency means more production, more profit, lower costs and better customer service. That is particularly true in an electric motor repair shop where thousands of replacement parts and accessories must be stored in a readily identifiable and accessible manner. Unless this is done, valuable time and considerable frustration can be expended searching for a specific part. And the smaller the item, the more elusive it can be when needed.

SLIDE CLIPS suspend parts jars in neat rows; facilitate quick removal and replacement of containers; contribute to overall efficiency of repair shop operation.

Much of this can be, and has been, eliminated in many shops by using variations of the glass-jar storage method. Capped jars, with parts identification labels, rest on or are suspended from shelves and racks. Biggest advantage is quick visual identification and comparison of the old with the new. Substantial time has been saved at Whitney Electric Co., Toledo, Ohio, by using this system for a variety of small parts and repair accessories.

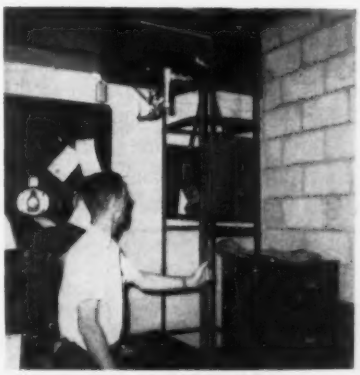
Latest improvement at the Whitney shop is a "jar-board" with rows of slide-clip wall brackets to suspend the parts jars. Brackets are made of sections of 2-in.-wide aluminum channel whose inner flanges engage a groove at the top of the 3-in.-high glass jars. The 68-in. by 44-in. board is made up of 20 standard panels mounted to a large pegboard backing on a wall under an open stairway. Each panel has 12 jars and clips (two rows of six each). To fit space limitations, one group of panels has 10 jars each. As installed, the board accommodates a total of 230 jars in 10 horizontal rows. The remainder of the pegboard to the right of the jars is devoted to a handy tool rack.

Filling and emptying the jars is a quick and simple operation. The mechanic merely selects the proper jar, pulls it out of its clip to get the part, and replaces the jar by sliding it back into its clip. Jars rotate freely in the brackets so identifying labels can always be adjusted for quick visual scanning. Whitney mechanics keep an assortment of bushings, fittings, lugs, connectors, screws, bolts, nuts and similar small items in these jars. They like the speed with which they can get what they want when they want it.

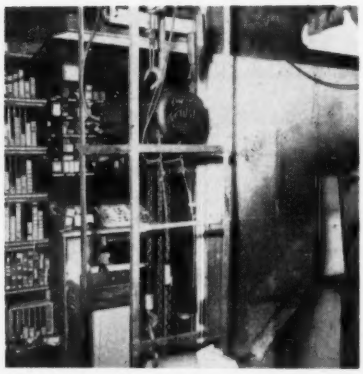
Simple Dumbwaiter Saves Shop Steps

Streamlined equipment handling facilities contribute materially to the overall efficiency of the modern motor service shop. These run the gamut from hoists, mobile carts and conveyor lines to various types of elevators in multi-story shops. Prime goal is to supplement the advantages of mechanized repair operations by minimizing the time required to move material from one place to another. Each improvement, large or small, adds to the service a shop can render its customers.

Customers of Lenawee Electric Company, Adrian, Mich., see and are impressed by one of these labor-saving devices each time they bring and pick up a small motor repair



ELECTRIC DUMBWAITER, riding angle-iron shaft, carries small motors between will-call counter and repair department in matter of seconds at Lenawee Electric Co. shop in Adrian, Mich.



TOP OF SHAFT has ⅛-ton electric hoist sling suspended from second floor ceiling. Control cables go down to first floor counter. Hoist can be operated from either location.

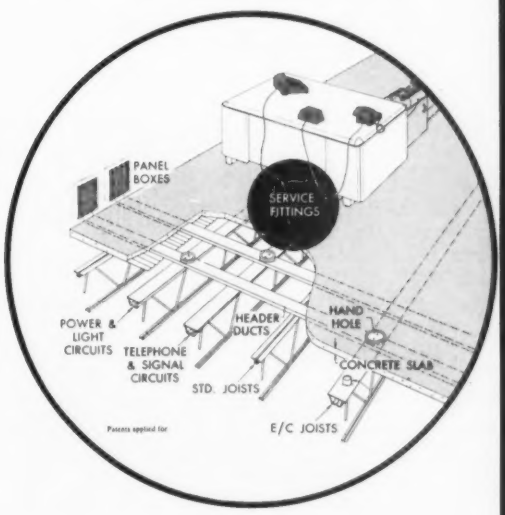
job. It is a simple motor-operated dumbwaiter connecting the "will-call" counter on the main floor with the fractional horsepower motor repair department on the second floor. Incoming work is ticketed, placed in the dumbwaiter "basket" and hoisted to the room above. Completed work is lowered in the same manner and placed on storage shelves to await pick-up. If a waiting customer's order is not already on the shelves, it can be located and sent down in a matter of seconds.

Four 1-in. angle-iron uprights, extending from ground floor level to the second-floor ceiling, form a 14-in. by 18-in. open shaft for the dumbwaiter. Numerous 1-in. flat-iron brackets, welded to the outside of the angle-iron sections, maintain framework rigidity and configuration. The uprights support little or no weight; act primarily as guide-rails for the dumbwaiter basket.

SHEET-STEEL BASKET, suspended from hoist hook, rides inside shaft uprights; has open side for loading and unloading ease. Finished motors on second floor are ready to be loaded.

THE NEWS IN UNDERFLOOR ELECTRIFICATION IS THE SAVING OFFERED BY CECO'S E/C JOIST SYSTEM

Whenever desks are moved, electrical outlets can be installed anywhere along the E/C Joists to service the new positions. Electrical, telephone and signal wires are run down through the floor at the service fittings, through the top chord of the E/C Joist, into the header ducts and on to the service panel boxes.



TOTAL MANUFACTURING FOR THE BUILDING INDUSTRY FROM RAW TO FINISHED PRODUCTS

When a method of construction offers quality at a cost lower than any competing system, that's a combination hard to beat. Add to that — practicality plus design that satisfies the future . . . then you can install with confidence. Such is Ceco's E/C Joist system of underfloor electrification. Savings are realized because Ceco's E/C Joists do two jobs: 1 — provide raceways for underfloor electrification; 2 — carry the floor load. Now any building "can afford" underfloor electrification. So, send for the facts now. Mail the handy coupon today. Ceco Steel Products Corporation. Sales offices, warehouses and fabricating plants in principal cities. General offices: 5601 West 26th Street, Chicago 50, Illinois.

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IN CONSTRUCTION PRODUCTS CECO ENGINEERING MAKES THE BIG DIFFERENCE . . .
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Please send me the following technical literature:
☐ E/C Joist Manual #3011-A ☐ Steel Joist Catalog #3001-P ☐ Joist Load Tables #3009

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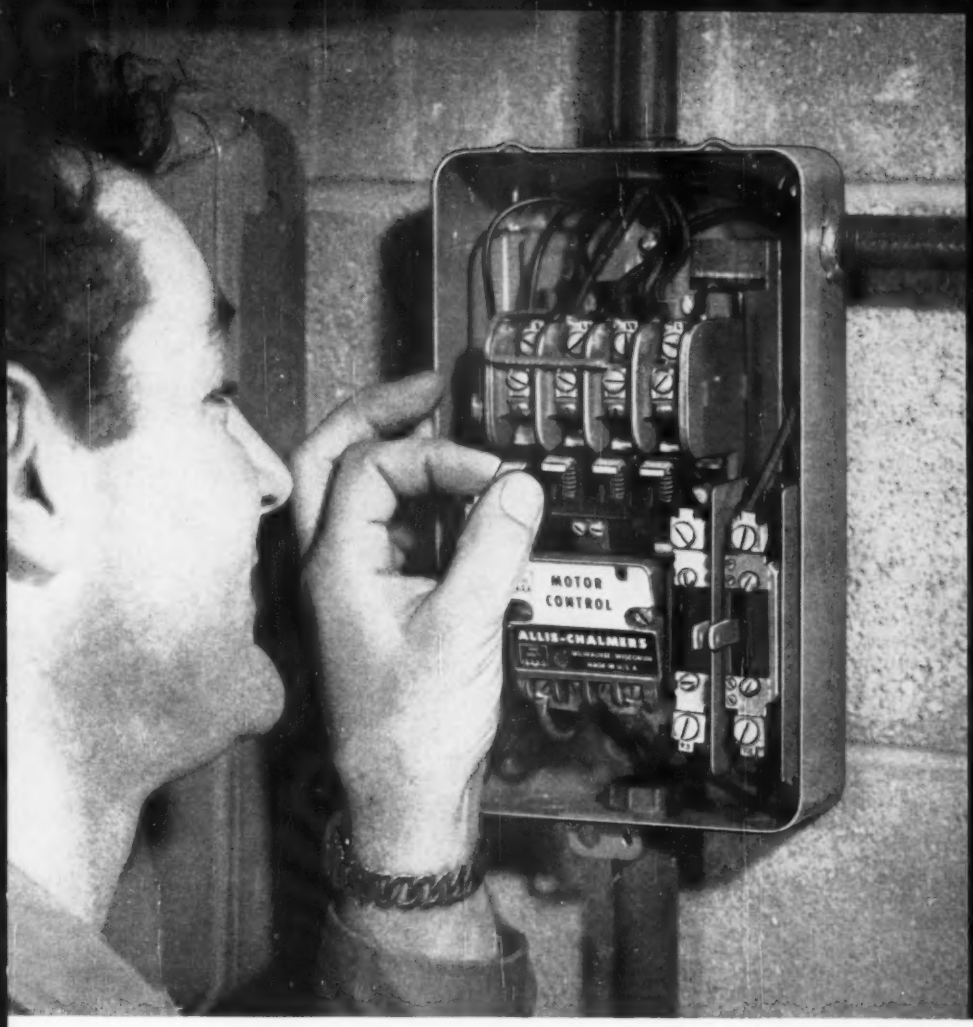
firm_____
address_____
city_____ zone_____ state_____
☐ If student, check here for special data.

MOTORS SLIDE easily on or off dumbwaiter at first-floor will-call counter. Handles of hoist control cables are shown at right of basket.

The sheet-steel basket has a 14-in. by 17½-in. base welded to three 18-in.-high sides. To facilitate loading and unloading, the open side of the basket faces the will-call counter on the first floor and an aisle in front of a receiving table on the second floor. An inverted-V lifting handle suspends the basket from a hoist hook and is welded to opposite sides of the basket. Handle stock is of sufficient diameter to prevent buckling under weight.

Power for the dumbwaiter is provided by a ½-ton electric hoist sling-suspended from the second-floor ceiling. The unit is positioned so the hoist chain is centered in the rectangular shaft opening. Wire-rope extensions on the hoist-control cables drop down to the first floor. Suitable hand grips located on the right side of the basket permit personnel on either floor to operate the unit.

MANAGER of the Motor Shop division of Barker-Fowler Electric Co., Lansing, Mich., is Mason Green. Mr. Green is also the current president of the Great Lakes Chapter of NISA.



WIDE OPEN for Fast Wiring and Inspection

NEW complete line of low voltage motor control

Wide-open accessibility and modern design assure fast and easy installation, modification, inspection and maintenance of this new line of Size 0 through 4 Allis-Chalmers control. For instance, large and clearly marked terminals, pressure connections for all wiring, wide and deep-cut screw slots, clearly visible contacts, easy coil replacement, readable rating plates, "out-front" overload relays.

Flexibility

This new line of control permits making many modifications in the field with ease. Minimum parts requirements facilitate delivery from local stock.

Unsurpassed Mechanical and Electrical Life

Millions of "life-test" operations attest to the functional quality in every detail — assure the ultimate in dependable performance and sure protection for personnel, motors and machines.

A complete line of low voltage control (Size 0 through 8) and high voltage control *in all NEMA* enclosures, plus engineered control systems. Your A-C distributor or representative will give you all the details. *Or write Allis-Chalmers, General Products Division, Milwaukee 1, Wis.*

Plan to stay ahead... MODERNIZE!

ALLIS-CHALMERS

A-5984

the main characteristic of every Sorgel dry-type transformer is...

QUIET QUALITY

Still setting the industry's pace for lowest sound levels . . . Sorgel's New 1960 Line features additional reductions in size and weight!

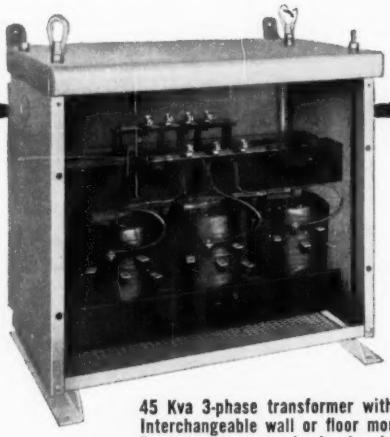
A great many independent authorities agree that Sorgel Sound Rated Dry-Type Transformers have historically been the industry's Quiet Quality line. Biggest human reason why: Men with a desire for excellence make Quiet Quality a crusade at Sorgel. Significant results: (1) The industry's lowest sound level. (2) Unexcelled overload capacity. (3) Unequalled operating efficiency. (4) Long range economy. Proof: Certified tests and case history engineering data, furnished upon request, substantiate Sorgel's Quiet Quality performance. Customer benefits: Complete satisfaction and appreciation.

Sorgel also offers these proven advantages:

- **Lower Copper Loss** — *Coils are liberally designed for the most effective use of the latest developments in insulating materials, have large air ducts for low hot spot temperature and are vacuum-impregnated to provide a co-ordinated insulation system.*
- **Lower Core Loss** — *Cores are designed with the industry's lowest magnetic flux densities, resulting in low core loss and the lowest sound level. Entire unit is secured within a substantial frame. Large units are mounted on vibration dampers to minimize vibration transmission to adjacent areas.*
- **Quicker, Easier Installation**—*The enclosure is self-supporting and entrance can be made on sides, top, bottom, or back. Connecting is made easier by means of solderless connectors on terminal blocks in roomy connection compartments. Units up to 75 Kva single phase and 45 Kva 3 phase are furnished for interchangeable wall or floor mounting.*

The same quiet SORGEL transformers are also incorporated in substations. Procurable with any type or make of switchgear, or from any electrical manufacturer. Contact Sorgel today for the Double "Q" in dry-type transformers . . . Quiet Quality.

1500 Kva, 3-phase, 12,000 volt unit substation with automatic fan cooling system to increase capacity 33%, primary fused load break switch, secondary metering with main fused switch and semi-drawout fusible feeder air circuit breakers.



45 Kva 3-phase transformer with taps. Interchangeable wall or floor mounting. Front panel removed, showing interior.

Complete Line for Every Purpose up to 10,000 Kva, up to 15,000 Volts, Including Special Transformers and Saturable Reactors

SORGEL ELECTRIC COMPANY

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Sales engineers in principal cities. Consult the classified section of your telephone directory or communicate with our factory.

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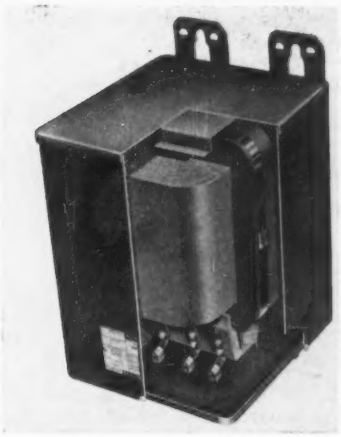
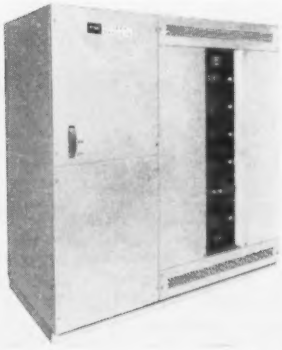
Product News



Transformers (1)

A complete line of 400-cycle dry-type transformers, EP, EPT, DS-3 and DT-3, from 500 kva, 600 volts and below, single and 3-phase, can be installed indoor or outdoor. Compound-filled construction of the EP and EPT transformers allows mounting in any position since core and coils are completely supported, and ventilating air ducts are not necessary. They are built in accordance with the latest revisions of ASA, NEMA and AIEE standards.

Westinghouse Electric Corp. P. O. Box 2099, *Pittsburgh*, 30, *Pa.*



Power Centers (2)

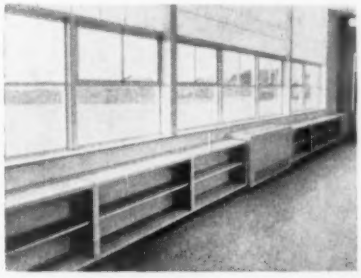
Package Power Centers, a new line of indoor unit substations are designed to transform and control power at primary voltages of 5 or 15 kv to secondary distribution voltages at the point of use. Each power center consists of a unit enclosure incorporating primary switch, transformer, and secondary distribution sections. Overall dimensions of units are 78 in. high, 98 ins. long, and 42 in. deep. Primary sections are available with 5 and 15 kv fused and non-fused load break switches, or with 5 and 7.2 kv fused and non-fused oil cutouts. Transformer sections, suitable for operation on 5 and 15 kv primary systems, are available in a wide range of sizes from 45 through 500 kva. They feature a 3-phase, 60-cycle Class B dry-type transformer with four 2½% full capacity taps.

Federal Pacific Electric Co., 50 *Paris St., Newark* 1, *N. J.*

Adapters (3)

A new series of bronze multiple cap terminal adapters for distribution transformers. Designated V&H Series, they allow the use of two or more cable taps from each secondary terminal. Adapters will accommodate up to six cables and cover a copper conductor range of No. 8 solid to 1000 MCM. Stud sizes range from ⅜ in. to 1⅝ in.

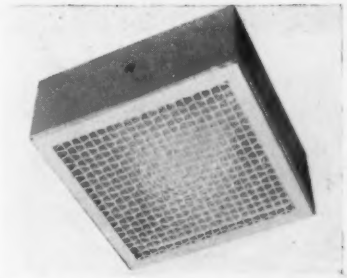
Anderson Electric Corp., Birmingham, Ala.



Draft Barrier Cabinets (4)

The new Chromalox draft barrier storage cabinets give storage space and with electric baseboard mounted behind the cabinets provide concealed perimeter heating. Cabinets and baseboards may be used as an independent room heater or with the Chromalox unit ventilator to eliminate downdrafts on long windows. If desired, baseboard may be installed first and cabinets added later when needed. Cabinet space and top grille are perforated to allow air circulation to baseboard heaters. Cabinets are available in 2-, 3- and 4-ft lengths, 26½ in. high, 13¾ in. deep and may be joined together for full wall coverage. Removable end panels are available.

Edwin L. Wiegand Company, 7500 *Thomas Blvd., Pittsburgh* 8, Pa.



Lighting Fixture (5)

A tamper-proof, vandal-proof lighting fixture for public buildings and areas accommodates up to two 100-watt A lamps in a double 14-gauge steel housing. Steel mesh is welded to the outer housing to protect Corning fresnel lens against vandalism. Theft is also prevented by spanner-head screws requiring a special screw driver for access to lamps. Other safety items include seating of lens in a shock-absorbing foam-rubber gasket, a fiber-glass insulation between fixture and ceiling, and safety chain to hold outer steel housing to inner housing to facilitate relamping. All component parts are phosphate-coated for rust prevention.

Delta Div., Light & Power Utilities Corp., 1035 *Firestone Blvd., Memphis, Tenn.*

Guard System (6)

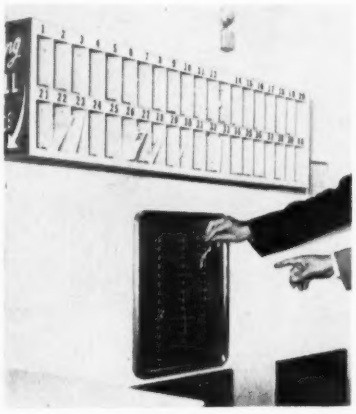
A new automated guard system offers industrial plants protection against intrusion, theft, fire and damage. In addition the system provides other policing duties such as surveillance and gate watching. And the system does this with a single human guard seated at a master control center from which he operates the electronic eyes and ears which are located throughout the plant. System protects for an entire industrial plant. The central console contains control switches, two-way intercom with outlying posts, alarm lights and signals and a 14-in. closed-circuit TV monitor picking up signals from surveillance cameras around the plant. Switches operate distant gates and control the fire and intrusion alarm systems. This system is adaptable to almost any set of protection requirements.

Minneapolis-Honeywell Regulator Co., 2753 *Fourth Ave., Minneapolis* 8, *Minn.*

Electric Heat (7)

A new method of installing electric heat in the concrete floor of hog farrowing and fattening pens, to prevent piglets from freezing in severe winter weather. Designated as Easy-Heat electric floor heater, it incorporates pre-spaced thermoplastic insulated resistance wire which is anchored in place in galvanized steel mesh mats 6 ft long and 18 in. wide. A safe heat of 42 watts per sq ft is dissipated on 230 voltage. Preassembled units may be rolled into place. Heater mats may be placed end to end, side by side, or in any special layout pattern desired, as long as they do not overlap.

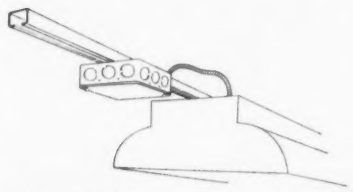
Easy-Heat, Inc., Lakeville, Ind.



Control System (8)

Complete remote control for electric heating systems designed for use with Markel baseboard Heetaires or with Series H-270 heavy duty fan-forced Heetaires. This low voltage remote 2-heat, hi-lo, control system makes it possible to regulate the temperature of all rooms individually and remotely from a central control panel. With a flick of a switch on the central control panel, the heat in any area can be increased or decreased. A double-setting thermostat permits switching to "high" for immediate increased heat and "low" for decreased heat. Unit air conditioners may be wired to the same power source as the heating units by use of a single pole, double throw selector switch in the heated area. As many as 56 separate units can be controlled from one remote control panel.

Markel Electric Products, Inc., Buffalo, N. Y.



Channel Bar (9)

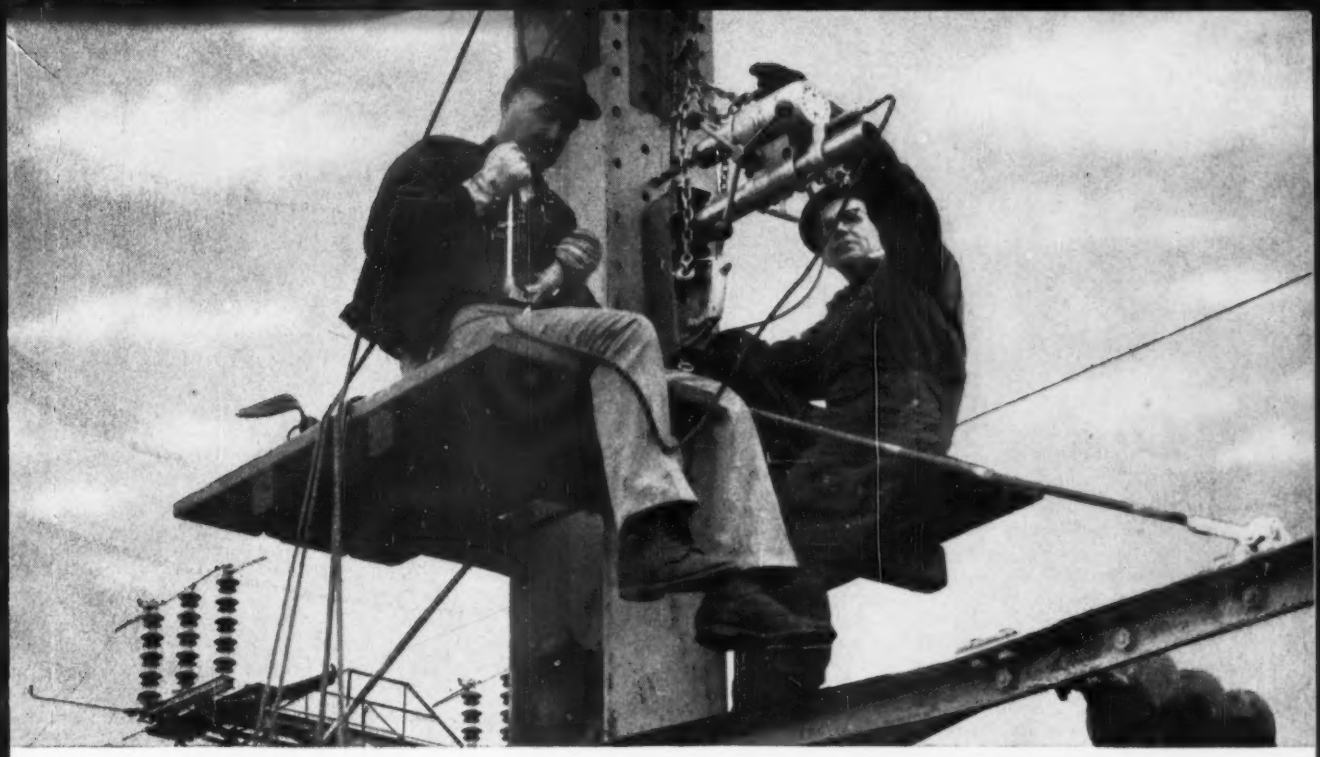
New all-purpose channel bar is especially suited for suspended ceiling construction for the simplified hanging of box units, fixtures and conduits. It is designed with a slotted opening that accommodates and permits easy positioning of the channel carriers, box fasteners, conduit clamps, or a simple ¼ in. sq nut and threaded rod. Available in two sizes and designed to be used separately or one inside the other. Both channels have a continuous slot opening of .28 in. The larger size is .388 in. deep with an inside width of .576 in.; the smaller channel has a depth of .263 in. and an inside width of .451 in. The channels are also available as a double bar assembly, with the smaller channel inside the larger. Channel bars are packaged in bundles of ten pieces of 10-ft lengths.

Steel City Electric Company, Pittsburgh 33, *Pa.*

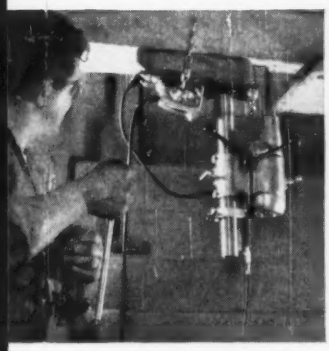
Luminaires (10)

A new series of luminaires—Achromatic, Prismalite, Wafer and Envoy—designed for use in schools, offices, institutions and public buildings. The Achromatic features controlled light refraction with the Achro-Lens, a crystal clear, one piece, wrap-around shield of extruded, color-stabilized polystyrene or acrylic shielding with uniform inverted prismatic lens pattern. Units are available in 2-, 3-, 4-lamp models in 4- or 8-ft lengths, shallow, surface or pendant mounted. Bulletin F is available.

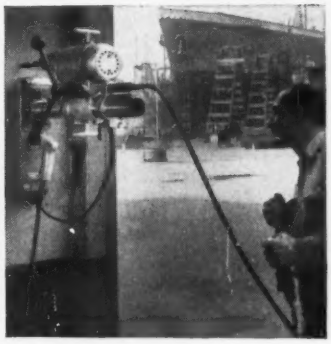
Keystone Electric Mfg. Co., Philadelphia 34, *Pa.*



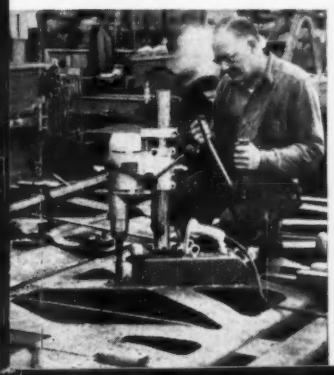
Job hard-to-reach, hard-to-handle?
Send for a B&D Magnetic Drill Press!



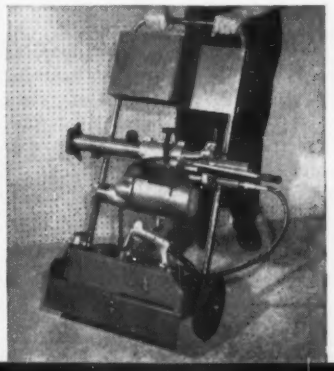
B&D 1¼" MAGNETIC DRILL PRESS works high overhead upside down; enables maintenance man to get into tight spots easily, rapidly.



TAKE 'EM ANYWHERE you need a drill press. Both are light weight, easily transported, simple to put to work; move to the next job.



B&D 1¼" MAGNETIC DRILL PRESS works upright on huge Air Chuck drilling and tapping; ready for instant moving to next operation.



B&D CADDY CART is the perfect way to transport your Magnetic Drill Press from job to job. Prevents damage to this peak precision tool.

Save hours . . . even days on every job . . . one use may pay for the tool!

Whether your job is production, construction or maintenance, a Black & Decker Magnetic Drill Press sticks like glue to the job. Lets you stand off and guide the bit from a distance. And it takes just finger-pressure to drill even a 1¼" hole with Black & Decker's exclusive Hydra-power Feed.

See one on your work. Two sizes to choose from: ¾" and 1¼"; both complete precision units—not attachments. Perfect for drilling, reaming, tapping in tool shops, steel fabricating, maintenance—anywhere you need a drill press but can't take the work to the tool.

Leading Distributors Everywhere Sell

Black & Decker®

Quality Electric Tools . . . Power-built for top performance

THE BLACK & DECKER MFG. CO.
Dept. 1201, Towson 4, Maryland

- ☐ Please arrange a demonstration of your ☐ 1¼"; ☐ ¾" Magnetic Drill Press
- ☐ Send me additional information
- ☐ Send me information on the tools checked below.

Name.....Title.....

Company.....

Address.....

City.....Zone.....State.....

☐ Impact Wrenches

☐ Hammers

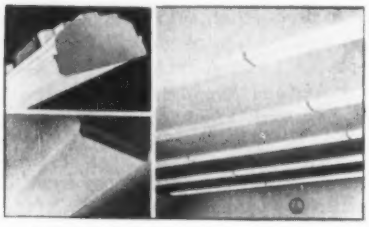
☐ Belt Sanders

☐ Drills

Fuse Puller Panel (11)

A new 100-amp parallel-connected fuse puller panel with 12 plug fuse branches and four branch pullers, one of which is sealable for use with separately metered equipment. Unit incorporates a 60-amp main puller for all plug fuse lighting and appliance circuits, another 60-amp puller for the range, and two 30-amp branch pullers. One of the 30-amp pullouts is independent of the main bussing and located in a sealable compartment. This puller can be used to control a water heater or other separately metered appliance. Listed by UL, panel is rated 120/240 volts ac, single-phase, 3-wire. Bulletin GEA-6286A is available.

General Electric Co., Plainville, Conn.



Ceiling Fixtures (12)

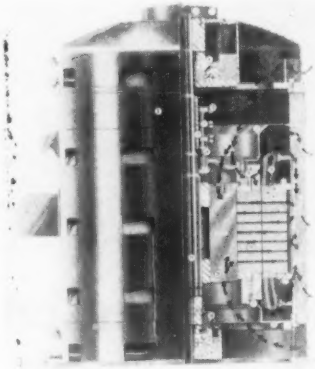
New 1200 series recessed integrated ceiling fixtures are designed for use with spline tiles or exposed T-bars. Fixtures are approved for use with 15,000-lumen lamps and are approved for use with fibrous Lo-Density tiles. Ballasts are mounted exposed on top. Ceiling suspends from fixture by means of patented extrusions.

United Lighting and Ceiling Co., 2828 Ford St., Oakland, Calif.

Floodlights (13)

A new line of "rear-lamped" floodlights for sports and industrial applications are designed to meet NEMA specification FL6-210, Group B, Types 1, 2, 3, 4 and 5. Reflectors are spun aluminum, finished in Anodal process. Rear section is attached to front reflector by three spring latches. Thermal shock and impact resistant lens in aluminum lens ring is removable. Each unit is equipped with shielded condensate drain, aiming devices, built-on service wrench, etc., and is weather-proofed with Silicone gasketing at all critical points. Bulletin No. 1097 is available.

Steber Manufacturing Co., Broadview, Ill.



Vertical Motors (14)

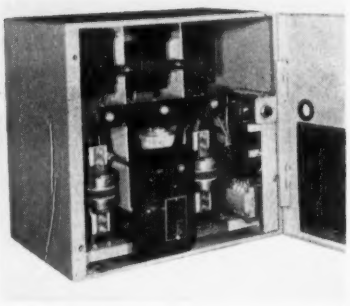
New high speed synchronous vertical motors in a wide range of enclosures are now offered in 150 hp and up, frames 584 and larger. Rotors are designed to resist torsional and centrifugal stresses. Couplings designed to protect the motor and the pump under specific conditions are available. Several methods of excitation can be provided, including direct-connected exciters, motor generator sets and excitation for the plant dc power supply.

Ideal Electric and Manufacturing Co., Mansfield 28, Ohio

Covers (15)

A new series of explosion-proof and dust-tight "GUB" series threaded Unilet covers are available in surface and dome types. Surface type is suited for small connection terminals or plain junctions. Dome type covers should be applied when large, oversized connection blocks or heavy wires are to be used. Inside diameter of both series range from 5⅛ in. up to 11⅞ in. Depth range of dome type cover is from 6 to 17 in. Covers are approved for Class 1, Group D, and Class 2, Group EF and G, and Class 3.

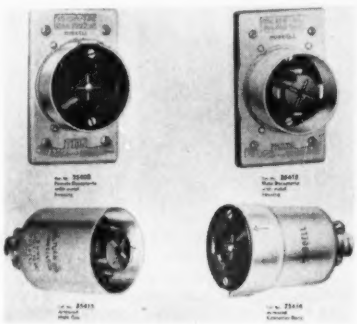
Appleton Electric Company, 1701 W. Wellington Ave., Chicago 13, Ill.



Fuse-Breaker Unit (16)

A new 600-volt 200,000-amp coordinated fuse-breaker unit known as "Fusematic." An integral unit combining components of conventional low-voltage power circuit breakers and current-limiting fuses, it is rated up to 1600-amp continuous and 200,000 amp interrupting capacity. Its primary application is for service entrance and feeder protection where high fault current exists. It measures 24 in. wide and 22½ in. high. Fusematic is available with either manual or electrical operation, has a frame size of 1600-amp and a range of coil ratings from 200 to 1600 amps. Can be supplied in either a fixed or draw-out mounting, with or without enclosures. Units stack four high in a 90 in. high enclosure.

Federal Pacific Electric Co., 50 Paris St., Newark 1, N. J.

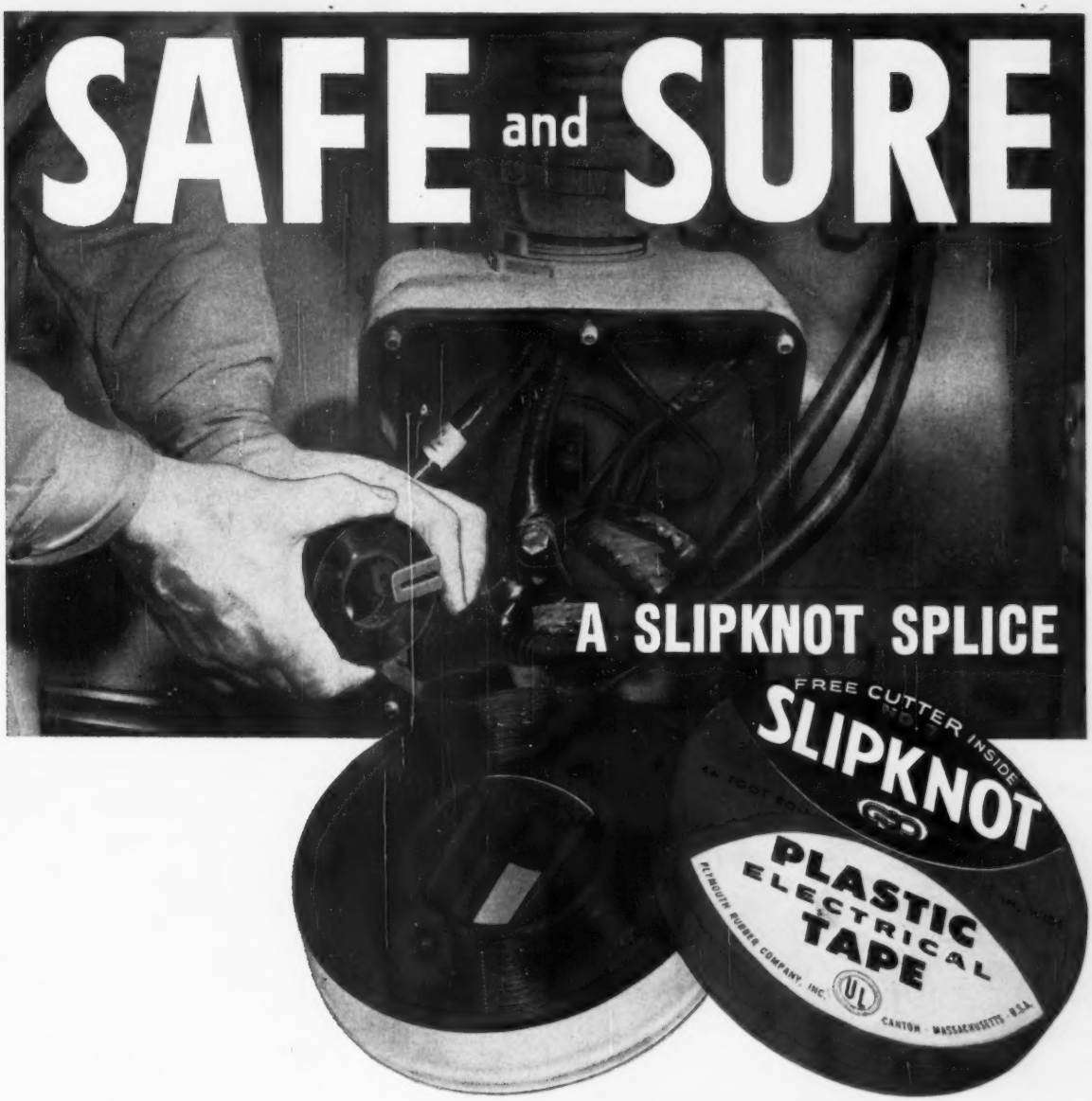


Wiring Devices (17)

A complete new line of 5-wire "Hubbellock" devices designed for 4-wire applications requiring additional equipment ground. Rated 30 amps, 600 volts ac and 20 amps, 250 volts dc, units include a male and female receptacle with metal housing, and an armored cap and body. All units are constructed for heavy duty applications involving high cycle tools and other portable equipment.

Harvey Hubbell, Inc., Bridgeport, Conn.

SAFE and SURE



the tape of the experienced electrician

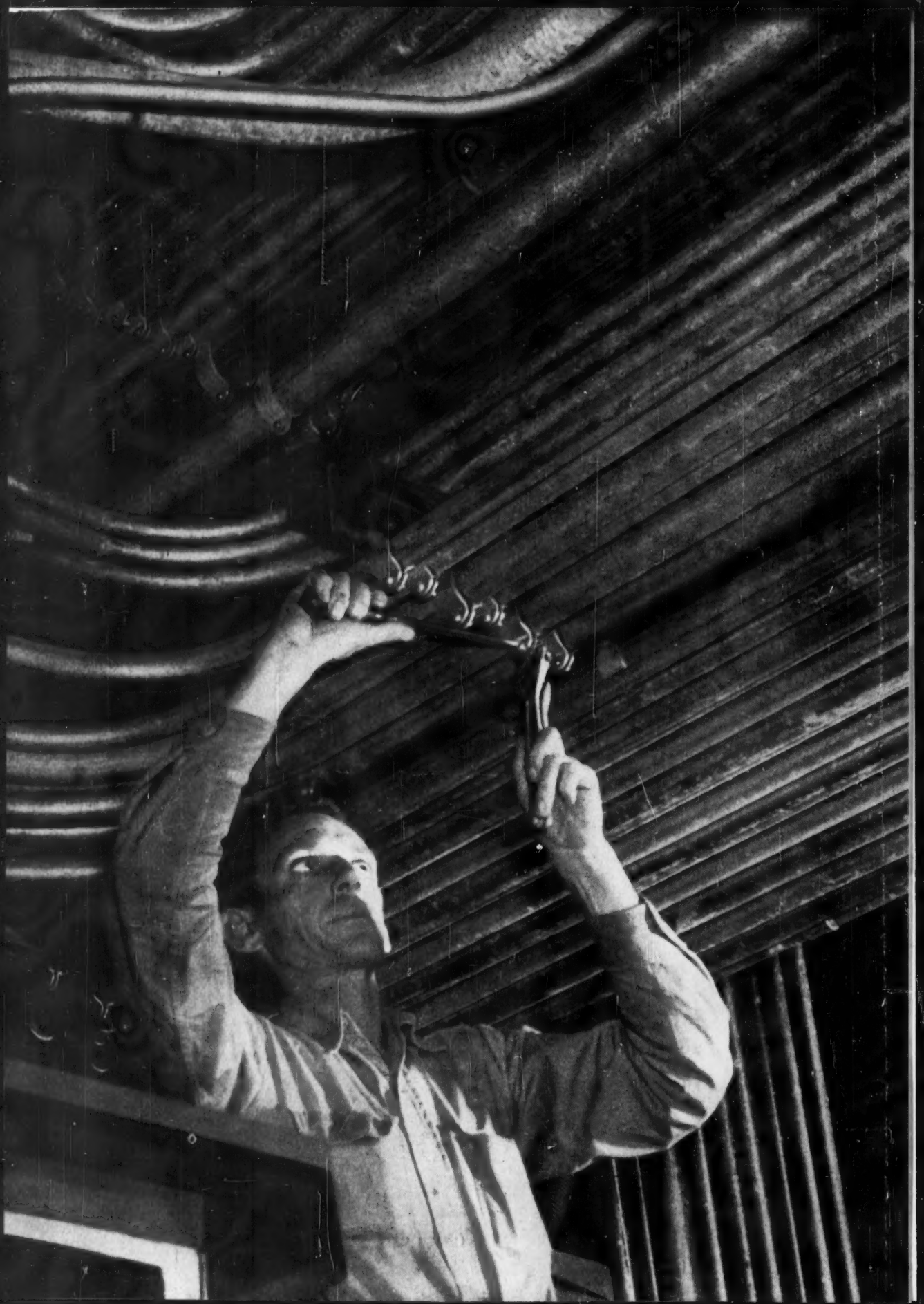
EVERY splice you make must be *final, permanent* and *safe.* SLIPKNOT PLASTIC TAPE is engineered for *dependable* adhesive quality and *proper* stretch to insure a neat, tight wrap that molds to any irregular shape and *stays down.*

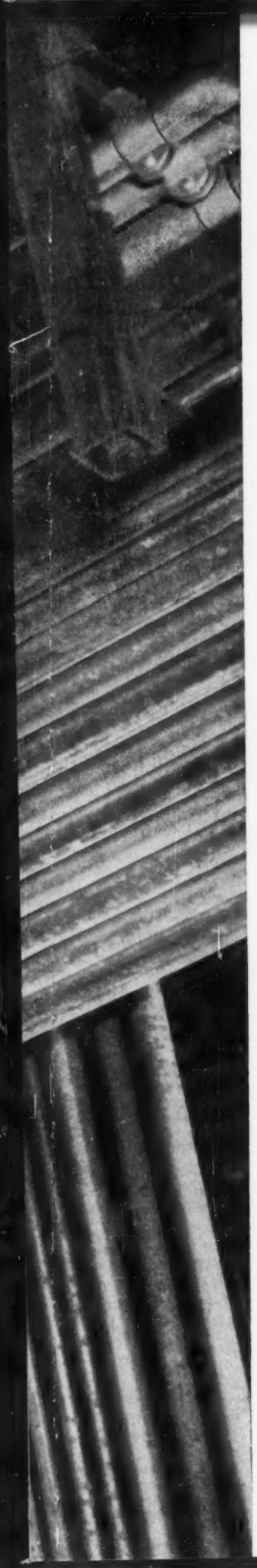
And Slipknot's patented, exclusive cutter, packed free with every 66-foot roll, solves the handling problem — swiftly, handily, easily. No waste... no distortion... no effort.

Next time, *specify* SLIPKNOT PLASTIC ELECTRICAL TAPE from your distributor.

SOLD ONLY THRU RECOGNIZED DISTRIBUTORS

PLYMOUTH RUBBER COMPANY, INC.
QUALITY SINCE 1896 CANTON, MASSACHUSETTS





PROBLEM:

Protection from high-voltage failures due to cable overload.

SOLUTION:

Build up a dependable power system for today and tomorrow—with high-voltage Anaconda Butyl (AB)—insulated Durasheath Cable.

Shutdowns caused by power failures usually entail significant losses; loss of labor during repair time . . . and in some cases, loss of goods in production. This is not to mention cost of repairs, both in labor and in cable. Many such power failures are the result of overloaded circuits—obsolete cables unable to handle the increased loads of today's stepped-up production, or the anticipated needs of tomorrow.

Is your plant's high-voltage electric power system limiting you? Make a careful check of it to find out. Then, if out-of-date or inadequate wiring is a problem, see your Anaconda distributor or the Man from Anaconda—about high-voltage butyl-insulated Anaconda Durasheath.*

High-voltage Anaconda Durasheath (5 kv and up) has been designed to give long life, dependable service. It is insulated with Anaconda Butyl (AB)—resistant to ozone, moisture, heat. Its tough neoprene jacket resists weather, soil conditions, abrasion and mechanical injury.

You can run Anaconda Durasheath from underground to overhead, and into ducts in one continuous run—without splicing. It is light, flexible, easy to handle, economically installed. For further information about Anaconda Durasheath write: Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y.

*Trademark 59981

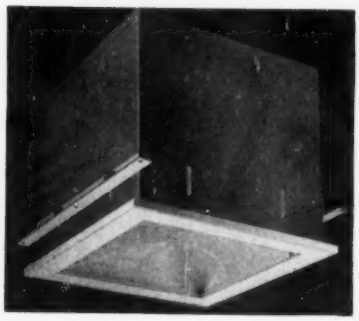
Durasheath has Anaconda Butyl (AB) rubber insulation for

- extra high resistance against ozone
- exceptional moisture resistance
- 22% more current-carrying capacity than 70 centigrade insulation

SEE THE MAN FROM

ANACONDA®

FOR BUTYL-INSULATED DURASHEATH



Recessed Unit **(18)**

New F-1565 series, a recessed luminaire, Lo-Brite, concave Controlens for 12-in. tile construction features a mechanical innovation—PAL, positive automatic latching. Unit features a die-case, corrosion-resistant cast zinc door and trim designed to fit into a 12-in. ceiling opening in a tile or plaster ceiling. Two mounting rails are furnished.

Holophane Company, Inc., 342 *Madison Ave., New York* 17, *N. Y.*

Light Control **(19)**

A new automatic post light control, called Mind-O-Light, turns post lights on at dusk, off at dawn. Unit can be used on any new or existing standard 3-in. post and standard base outdoor light. It is available in black or aluminum finish, with or without convenience outlet. Rating is 5 amps. Unit is installed for over-control by wall switch in the home. Brochure 124 is available.

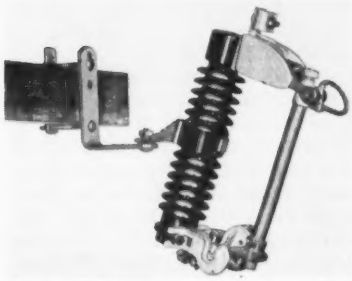
Virden Lighting, Division of John C. Virden Co., 5209 *Euclid Ave., Cleveland* 3, *Ohio*

Anchors **(20)**

A complete line of 4-way expanding anchors as well as a line of gray- iron cone anchors. The EEA expanding earth anchor features 4 extra-long V-Way blades which are

heavily flanged. Anchor base incorporates specially designed indentations to assure proper guiding and nesting of V-Way blades when expanded. Anchors are available in eight different sq-in sizes and in two different base sizes—8 and 10 ins. CEA type cone anchor line is cast from gray iron and has its own cast-in nut retainer. Anchor is available in the 8-, 10-, 12-, 16-, 19- and 26-in. dia. and is also specially coated with a special asphalt compound for corrosive soil conditions.

Penn-Union Electric Corp., 315 State St., Erie, Pa.



Open Cutouts (21)

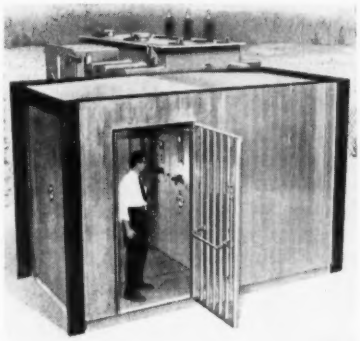
A new line of 100-amp open cutouts, designated Type LMO, have voltage ratings of 7.8, 15, and 27-kv and feature high interrupting ratings of 20000, 16000, and 6000 amps, respectively. They afford fault-current protection to distribution systems with voltages of 7200 volts delta through 14400/24960 volts grounded wye. Interchangeable fuseholders accept any EEI-NEMA standard button-type fuse link. LMO aluminum parallel-groove terminal connectors accommodate conductor sizes through 4/0 ACSR and can be adjusted for either horizontal or vertical wire entrance.

Line Material Industries, McGraw-Edison Co., Milwaukee 1, Wis.

Pump Motors (22)

A new line of dripproof close coupled pump motors in new NEMA rerated frame sizes, from ½ hp at 900 rpm through 75 hp at 1800 rpm —frames 182 through 405 U. Explosion-proof and totally enclosed fan-cooled from ½ hp, 900 rpm thr ugh 30 hp. Frames 182 through 326 U. Stator windings are impregnated with moisture-resisting, thermosetting insulating varnish. They can be furnished either 2- or 3-phase.

Lima Electric Motor Co., Inc., Lima, Ohio



Switchgear Housing (23)

The new Aluma-Clad housing design for metal-clad switchgear permits an increased flow of air through filters in bottom and out the top of housing. This feature is a result of the open-labyrinth cross-section of the panels which snap together to form walls, floor and roof. Major sections are joined by aluminum alloy bolts with closed-cell neoprene gasketing between adjacent panel sections. Directed air flow within the switchgear housing keeps internal heat at a minimum. Removable floor panel extrusions permit access to the area beneath the switchgear housing. Aluma-Clad outdoor housings can be furnished only with Allis-Chalmers line of high voltage switchgear.

Allis-Chalmers Manufacturing Co., Milwaukee 1, *Wis.*

Relay (24)

A new pneumatic relay is now available for applications where two separate timers would normally be used for on-delay and off-delay operation. Two timing heads operate from a common magnet assembly to provide time delay after energization and time delay after de-energization. Each timing head has a single-pole double-throw snap switch with an adjustable timing range of .2 seconds to 1 minute. Mounting dimensions are the same as the Type DO relays and Types A and H timers. Bulletin 9050-10 is available.

Square D Company, 4041 *North Richards St., Milwaukee* 12, *Wis.*

Flood and Spot Lights (25)

New Circle-D 1050 Series of flood and spot lights is designed to accommodate sealed beam lamps such as R-52, R-57 and R-40 long neck types. Constructed of heavy cast aluminum alloy, double cushion lamp support protects against shock and vibration. Base support is a

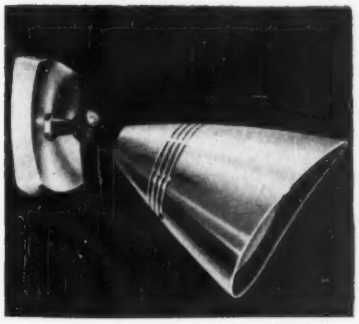
floating spring mounted mogul socket; globe is supported by a heat and cold proof resilient ring gasket. Lights are furnished in two models, high bay and standard, with friction clutch, swivel arm for pole or trough mounting.

Natale Machine and Tool Co., Carlstadt, N. J.

Potentiometers (26)

Oil-tight potentiometers have been added to this line of pushbuttons, indicating lights and selector switches. Ready-to-mount, units are available in three models—a single element, 2-watt; a dual element, 2-watt; and a single element, 25-watt. They can be base or one-hole mounted. The operating knob on device, indicator ring and subpanel operators are independently adjustable.

Cutler-Hammer Inc., 228 N. 12th St., Milwaukee, Wis.



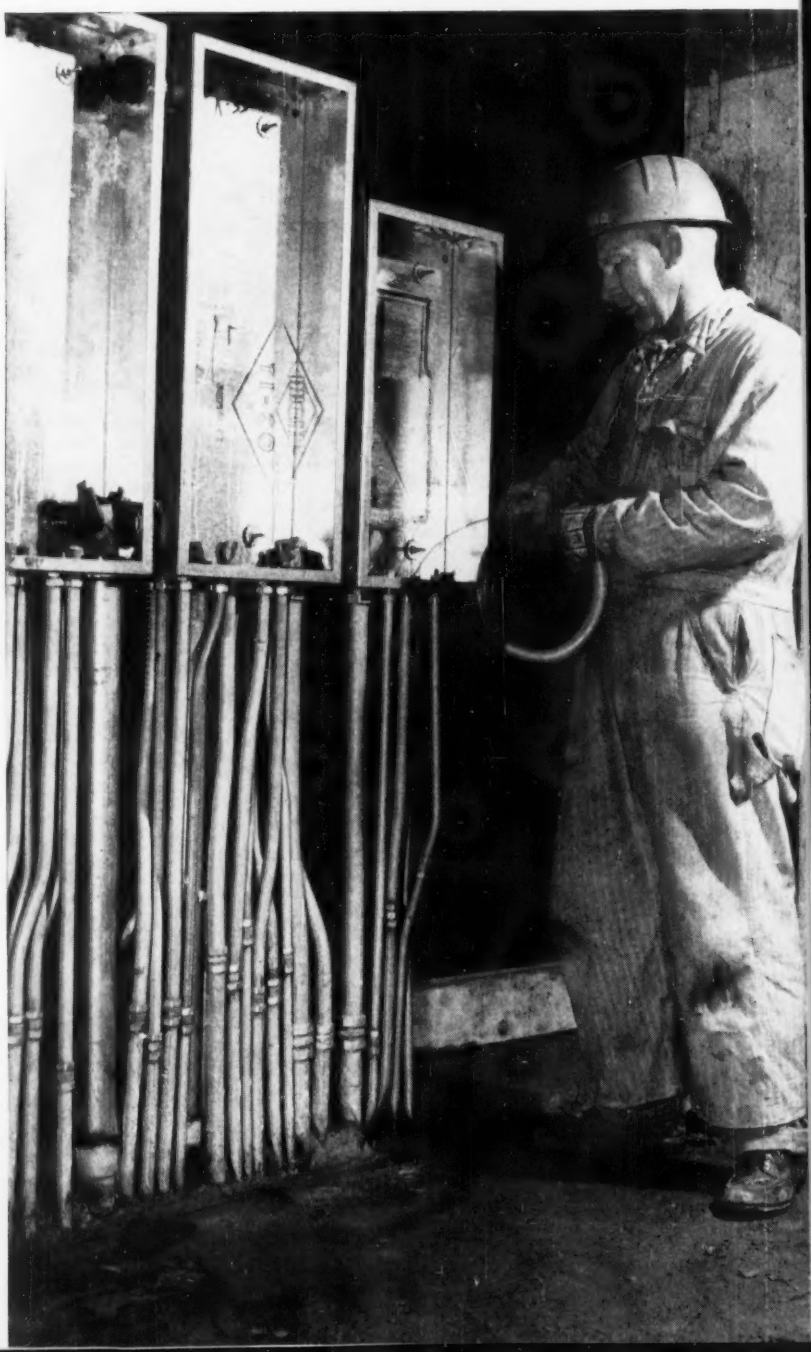
Outdoor Floodlights (27)

Weatherproof decorative floodlights are designed for outdoor use, and are available in three bullet shapes with a wide range of colors and finishes. These fixtures have a high temperature silicone-rubber weatherseal to protect the lamp in any position, and take up to a 300-watt medium-base lamp. Fixtures feature vented ribs designed to provide cooler cleaner operation, and longer lamp life.

Stonco Electric Products Co., 333 Monroe Ave., Kenilworth, N. J.

"Zingo! She's done"...

describes why THE BEST

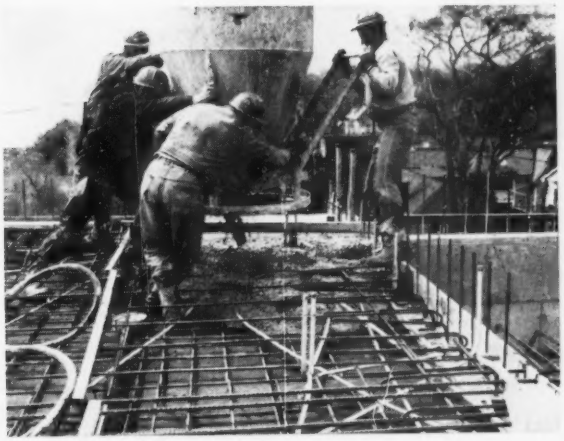


REPUBLIC ELECTRUNITE® E.M.T. is produced from highest quality flat-rolled, open-hearth steel, controlled by Republic through every step of manufacturing from ore to finished product. ELECTRUNITE E.M.T. was used in the construction of the new Y.M.C.A. Building, Racine, Wisconsin. Architects: Grassold-Johnson, Associates, Racine, Wisconsin. Electrical Contractor: Dave Speaker Company, Kenosha, Wisconsin.

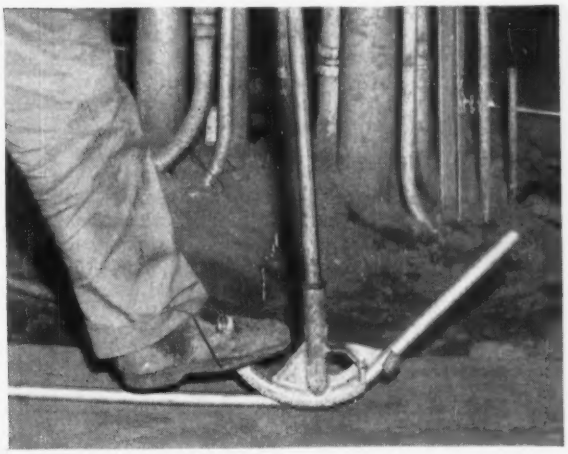
PULLING A PAIR of #8's and a #10 over tight bends is a lot easier with the Silverslick inside finish. You can feel the difference. That's the way Ray Konkol described ELECTRUNITE's "INSIDE-KNURLING" and exclusive Silverslick finish.

COSTS LESS INSTALLED with

REPUBLIC ELECTRICAL METALLIC TUBING



ELECTRUNITE'S tightly adhering galvanized coating protects against corrosion — won't peel, chip, or flake off during bending. Resists galvanic action. Millions of feet have been successfully used in slab concrete installations over the past twenty-five years. Still in service, ready for more service tomorrow.



IN REFERRING TO ELECTRUNITE's "INCH-MARKED"® AND "GUIDE-LINED"® features, Ray Konkol commented: *"We needed a 14-inch right angle bend so that there would be enough stubbing after the concrete pour. "INCH-MARKS" make it easy. Just check off 14 inches and subtract the bender allowance. Put the bender on the mark and zingo, she's done."*

"Zingo. She's done", is the way Ray Konkol describes the use of Republic "INCH-MARKED" ELECTRUNITE E.M.T. He's the on-the-job foreman of Dave Speaker Company, electrical contractors, Kenosha, Wisconsin.

"Pulling a pair of #8's and a #10 over tight bends is a lot easier with the Silverslick *inside finish. You can feel the difference"*, Ray added. Electrical contractors everywhere like the easy wire pulling qualities of ELECTRUNITE's "INSIDE-KNURLING" with exclusive Silverslick finish.

In referring to ELECTRUNITE's full-length "GUIDE-LINE", Ray said: *"The centerline on* ELECTRUNITE *makes it a lot easier when you have several double offsets. Without the centerline as a guide, bends can get out of line and wind up several inches from where they're wanted."*

Buy and try the economies of Republic ELECTRUNITE E.M.T. on your next job. These same ease of installation advantages can be yours. To learn more about Republic ELECTRUNITE E.M.T., call your Republic representative. Or, write direct.

REPUBLIC STEEL

World's Widest Range of Standard Steels and Steel Products

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION
DEPT. C-8826
212 EAST 131st STREET • CLEVELAND 8, OHIO

I want to know more about the installation advantages of Republic ELECTRUNITE E.M.T.

Name_____ Title_____

Firm_____

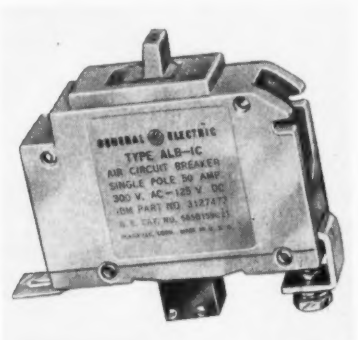
Address_____

City_____ Zone____ State_____

Recessed Fixtures (28)

All-glass, frameless, recessed fixtures, called "Glass-Lite," are suspended from recessed box and project 2¼ in. from ceiling. They are designed to accommodate 60- and 100-watt lamps, will accept both unwired or pre-wired recessed boxes. They are ideal for outdoor use.

Markstone Mfg. Co., 1531 Kingsbury St., Chicago 22, Ill.



Circuit Breaker (29)

A new low impedance, high shock circuit breaker, ALB-1C, is available in ratings 5 to 75 amps and features inverse time delay action for use in electronic applications. It has a thermal bi-metal and independent magnetic trip element and is available with or without an auxiliary switch. Interrupting capacity is: 5-amp breaker—1500 amps, 125 volts ac and dc; 800 amps, 300 volts ac and 10—75-amp breakers—1500 amps, 125 volts ac and dc, 2500 amps, 300 volts ac.

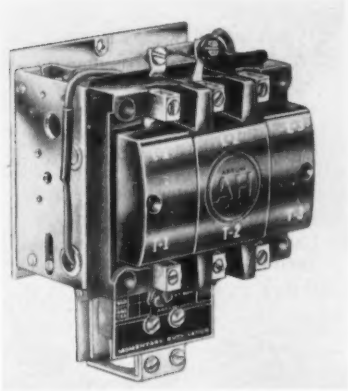
General Electric Company, Circuit Protective Devices Dept., Plainville, Conn.

HF Bus Duct (30)

Bus duct to distribute high-frequency power with minimum voltage drop and with little change in phase relationship is available. Maximum voltage drop at 400 cycles per second is 1.28 volts per 100 ft,

and duct will operate with high efficiency at frequencies up to 1000 cycles per second. Individual conductors in the four-channel rigid aluminum housing are continually transposed and rotated while housing grounds stray radio frequencies. Four openings are provided in each 10-ft section of duct to take off power through standard "EH" frame circuit breaker plug-in units.

Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa.



Contactors **(31)**

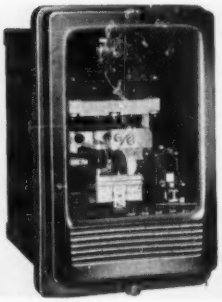
A new line of Type "CRA-MH" mechanically held contactors are supplied in NEMA Sizes 0 through 5, with 2, 3 or 4 poles. They are electrically operated switches that are closed by the momentary energization of a coil, and then held in the closed position by a mechanical latch. To provide convenient remote-control operation, these contactors are equipped with a second coil. When this is momentarily energized by a pushbutton, float or pressure switch, or other suitable pilot device, the mechanical latch is released, letting contacts open through the action of gravity assisted by compression spring action.

Arrow-Hart & Hegeman Electric Company, Hartford, Conn.

Wall Plates **(32)**

Sectional wall plates make it simple to arrange any desired combination of switches, outlets or wiring devices. They are made of plastic in brown or ivory and are self-aligning with a lug and slot arrangement which locks the sections securely. The end and center sections come in nine styles.

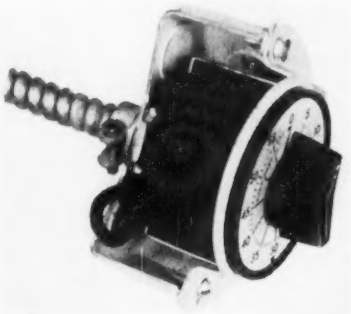
Pass and Seymour, Inc., Syracuse 9, N. Y.



Relay (34)

A new directionally-controlled timing relay, type CRN-1, is for reverse-power, 3-phase applications. It is rated 120 volts line-to-line, 5 amps. Main contacts can close 30 amps at 250 volts dc and carry this current for sufficient time to trip a circuit breaker. Features include high sensitivity of 0.02 amp, 120 volts at maximum torque, adjustable timing range from 2.0 to 40 seconds, small-size Flexitest case, and low burden. Relay is self-contained.

Westinghouse Electric Corp., P. O. Box 2099, *Pittsburgh* 30, *Pa.*



Adapter Plate (35)

Adapter plates are now available for mounting "Mark-Time," 70,000 series, panel mounted time switches in 4-in. octagon switch boxes. The plate converts existing toggle switch operation to time switch operation for control of tumbling machines, plating equipment, food mixers, fan, etc. Literature is available.

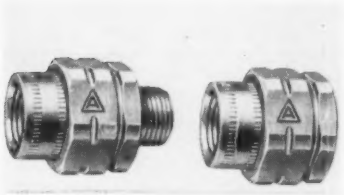
M. H. Rhodes, Inc., 30 *Bartholomew Ave., Hartford* 6, *Conn.*

Mercury Luminaire (36)

Integrally ballasted mercury luminaires, designated Line 2A2, are designed for high level lighting of streets, highways, and parking areas. They are equipped with an adjustable mogul socket, a one-piece heat-resistant glass refractor, and a 120/240, 277, or 240/480-volt con-

stant wattage or reactor ballast. A series ballast is also available. The luminaires are furnished for use with or without a photoelectric control and accommodate clear or color-improved, mercury lamps rated through 400 watts. The adjustable slip fitter compensates for pole rake for either 1¼-in. or 2-in. pipe.

Line Material Industries, McGraw-Edison Co., Milwaukee 1, *Wis.*



Explosion-Proof Union (37)

New small style explosion-proof union for use in installing rigid conduit and fittings in hazardous areas. They are available in only the ½ in. size and listed by UL for Class 1, Groups A, B, C and D and for Class 2, Group E, F and G.

Appleton Electric Co., 1701 *Wellington Ave., Chicago* 13, *Ill.*

Batteries (38)

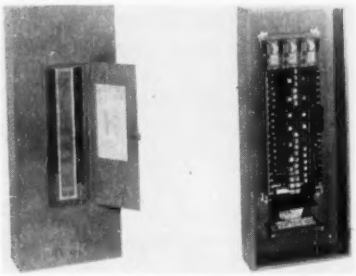
A new line of stationary batteries for use where batteries are used as standby emergency power. Available in 50 to 1140-amp hour capacities, the calcium batteries are designed for full float service. Plastrite jar permits increased battery room capacity and reduces storage rack requirements. Acid-proof seal eliminates corrosion and wet covers. Terminal posts have a high ratio of contact of posts to connector. All posts have bolt holes in both directions that permit assembling cells end to end or side to side.

Gould-National Batteries, Inc., Trenton 7, *N. J.*

Drum Switch (39)

A drum switch for control of single-speed electric motors up to 2 hp has been introduced. Visible contacts, positive spring-action handle and large, front-accessible, screw-type terminals are some of the features. Operation of spring-action handle causes contacts to open or close, providing starting, stopping or reversing of a motor. Two conduit openings at bottom of enclosure permit separate openings for incoming and outgoing leads. Overall dimensions, including handle, are: 4⅜ in. high, 2⅞ in. wide, 4⅛ in. deep.

General Electric Company, Schenectady 5, N. Y.



Load Center (40)

A new Stab-Lok load center that extends this line of enclosures and breakers into commercial and industrial applications. A double bus design increases circuit capacity. By having four rows of breaker plug-in slots, the new Stab-Lok load center permits 100-amp breakers to be mounted opposite each other. Space for 28 to 42 circuits is allowed in load centers, which are available both in single and 3-phase. By the proper combination of panels and Stab-Lok 1, 2, and 3-pole breakers, power panel applications up to 400-amp mains, 240 volts, and branches of 100-amp can be met. Modular construction permits on-the-spot assembly.

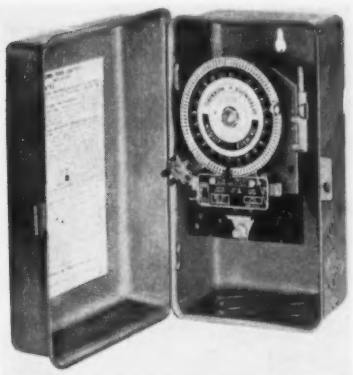
Federal Pacific Electric Co., 50 Paris St., Newark 1, N. J.

Floodlight (41)

New heavy-duty Bell Holder is vaportight and for use in all locations exposed to weather elements, corrosive fumes, non-explosive vapors and gases or non-combustionable dusts. Features include "shield" design, pre-aiming quadrant permitting on-the-ground focusing, and a variety of job-tailored accessory fittings for pole-top, midpole, wall or cross-arm mounting. Aluminum line includes Bell Hold-

ers for medium and mogul base reflector lamps up to 500 watts as well as lightweight portables. Bulletin B-901 is available.

Stonco Electric Products Company, Kenilworth, N. J.



Time Switch **(42)**

A new momentary contact time switch developed for the direct control of mechanically-held contactors and low-voltage lighting systems. Unit operates on a new time switch principle of providing a 3 to 5 second "pulse" for On or Off switching. On-off times are set by placing trippers at the precise times (on the dial) the switching is desired. Switching is single-pole double-throw. Dials and types of schedules are 24-hour dial; astronomic dial; and skip-a-day. Units also have a manual on-off switch. The MC is also available with Reserve Power. Bulletin No. 257P is available.

Tork Time Controls, Inc., Mount Vernon, N. Y.

Portable Heaters **(43)**

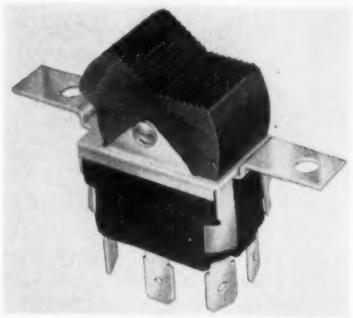
Heavy-duty portable electric heaters have a number of improvements in the new HDP 240-volt series, and replace the MHF series. A new hydraulic type thermostat is provided, and will automatically maintain any temperature desired. For finger tip control, the control knob is located on top of the heater. Other features in the new line include a balanced fan with a metal baffle that draws cool air in through the rear of the heater, and a positive pressure-type tip over switch. All models are thermostatically controlled, and are equipped with a 3-wire cord. Heaters operate on 240 volts, with wattages of 3,000, 4,000, and 4,800.

Thermador Electrical Mfg. Co., 5119 District Blvd., Los Angeles 22, Calif.

Wiring Device (44)

Switches and outlets with built-in automatic wire stripper and Pressure-Lock terminals. The procedure for stripping any AWG No. 12 or No. 14 wire is to insert wire into stripper opening to depth of mounting screw which is held captive in device. A simple pull and insulation is stripped clean to the exact length required for the patented G-E Pressure-Lock terminals.

General Electric Company, Wiring Device Department, Providence 7, R. I.



Rocker Switch (45)

A new series of rocker-actuated 20-amp switches for the control of a variety of industrial and consumer products. Switches feature heavy duty construction. Basic switches are available with flush or offset 2-hole mounting. Varied colored serrated actuators may be plain or marked to fit application. Ratings are 20-amp, 125-volt ac, 1½ hp; 10-amp, 250-volt ac, 2 hp. UL approved.

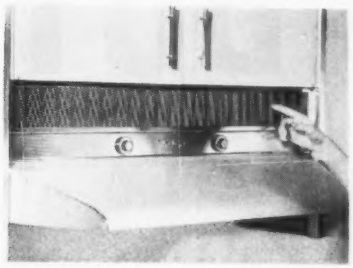
McGill Manufacturing Co., Inc., Valparaiso, Ind.

Case for Switches (46)

A new raintight case, designed to protect outdoor time switch installations from weather elements. Measurements are 6½ in. wide, 9⅝ in. high and 3⅜ in. deep. Side hinged door is rubber-gasketed. A

hasp is also provided for sealing or padlocking. Five knockouts, one in back and each side and two on bottom allow access to terminal block. Four mounting holes included. Case is available for all Intermatic "T" Series time switches. It is approved by UL.

International Register Co., 2624 W. Washington Blvd., Chicago 12, Ill.



Range Hood **(47)**

A no-duct range hood that eliminates smoke, grease and odors. The 4-speed fan in the new "Triple-Aire" hood pulls the grease-laden air into a large aluminum mesh filter directly above the range. After being freed of grease, the air passes through the special "Micro-Flo" filter which removes smoke, and then through an activated charcoal filter which eliminates odors. It extends 21 in. from wall to completely cover front burners. It is available in 30-, 36- and 42-in. widths in satin anodized aluminum, copper anodized aluminum, copper enamel, antique copper enamel and stainless steel. It may be attached to cabinets or a wall shelf. Wiring can be plug-in or concealed.

NuTone, Incorporated, Madison and Red Bank Roads, Cincinnati 27, Ohio

Saw **(48)**

Cutting action of a new power hand saw is provided by a special reciprocating blade mounted on a rigid backing. Blade cuts on both forward and return strokes. Entire length of blade is usable to give 8-in. maximum cutting capacity. Construction features include anti-friction ball and needle bearings, helical gears, specially designed heavy duty ac/dc motor, die cast housing and double pole switch that breaks both lines. It weighs approximately 8 lbs.

Wells Manufacturing Corp., 250 Service Road, Three Rivers, Mich.

EXCLUSIVE WEATHER LIFEGUARD™ ARC TUBES

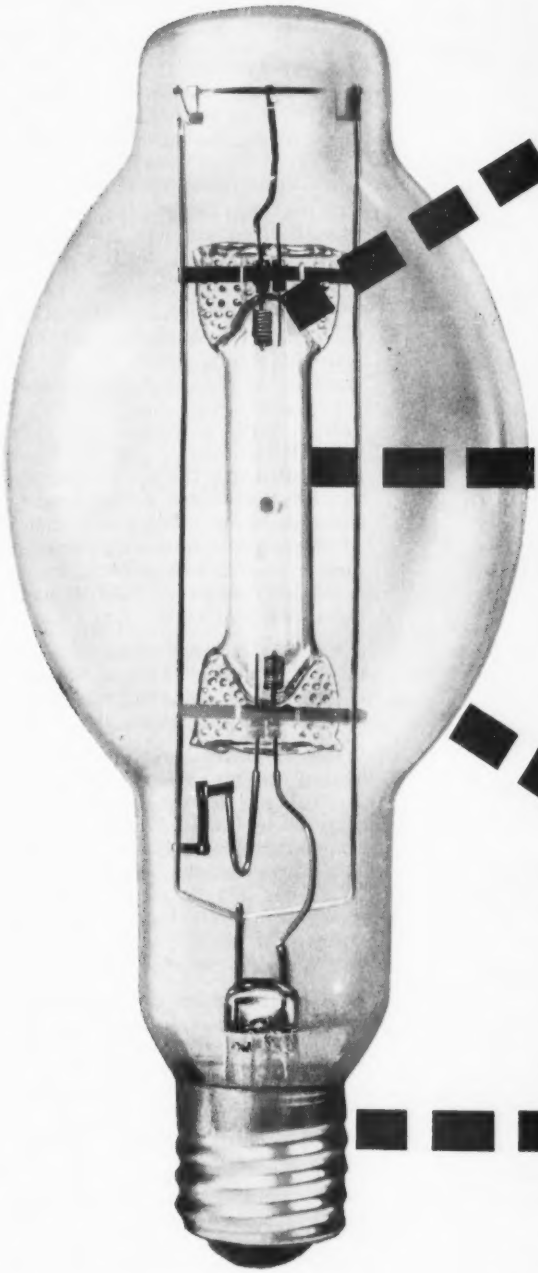
YOUR BEST BUY

IN MERCURY LAMPS!

By any standard of comparison, new Westinghouse "Lifeguard" mercury lamps are the most economical choice for industrial, street, and parking lot lighting. The exclusive Westinghouse "Lifeguard" arc tubes in these lamps save you money by maintaining high initial light output longer. And, they make possible lower-cost new lighting installations.

In addition to getting more light per dollar, you save on labor and maintenance costs, too, with less frequent lamp changing. And "Lifeguard" lamps are made with famous Westinghouse "Weather Duty" bulb construction for resistance to thermal shock, moisture and all industrial fumes. New Westinghouse "Weather Duty" lamps with "Lifeguard" arc tubes are interchangeable with other types of the same wattage. Make the change today. Contact your authorized Westinghouse lamp agent or nearest Westinghouse sales office.

DUTY™ LAMPS WITH MAKE WESTINGHOUSE



New design electrodes with specially-compounded and locked-in emission material virtually eliminate light-robbing arc tube blackening.

"Lifeguard" arc tube improves lumen maintenance . . . 85 percent of initial light output after 10,000 hours.

First with "Weather Duty" lamps . . . fume-proof and moisture-proof, shock-resistant glass.

Permanent-grip silicone cement holds bases tight for the life of the lamp. Remains strong at high temperatures. No strain on glass.

YOU CAN BE SURE... IF IT'S Westinghouse

Westinghouse Lamp Division · Bloomfield, N. J.

Product Briefs

(49) The Allen-Stevens Conduit Fitting Corp., Woodside, N. Y., has announced the availability of a new line of EMT set screw **fittings.**

(50) Development of a new low-temperature curing silicone impregnating **varnish** which develops outstanding electrical properties at 150°C, has been announced by General Electric Company's Silicone Products Department, Waterford, N. Y. . . . (51) Matched **plugs** and **receptacles** to make it convenient for service crews to take power from street lighting or other fixtures, yet prevent tapping by unauthorized persons, have been developed by J. B. Nottingham & Co., Inc., New York, N. Y.

(52) The Peerless Electric Division, H. K. Porter, Inc., Warren, Ohio, has introduced an all-new stainless steel canned **pump motor** for handling nuclear contaminated, highly corrosive or highly volatile liquids. . . . (53) Westinghouse Electric Corp., Pittsburgh, Pa., has developed a new **insulation** that can be painted or sprayed on electrical equipment subject to high-voltage discharges that cause rapid breakdown of conventional insulating materials.

. . . (54) A new series of non-relaxing hot line **clamps** is now being offered by Anderson Electric Corp., Birmingham, Ala.

(55) A newly developed and improved version of No. 30 high voltage splicing **tape** is being manufactured by Bishop Manufacturing Co., Cedar Grove, N. J. . . . (56) Tele-Norm Corporation, New York, N. Y., has introduced a miniature pushbutton telephone **intercom system** for small factories, business firms, stores and institutions.

(57) A new extra heavy-duty saber **saw,** the H 76, has been introduced by Stanley Electric Tools, division of the Stanley Works, New Britain, Conn. . . . (58) A new line of electric heating **thermostats** has been developed by Penn Controls, Inc., Goshen, Ind.

(59) Permacel, New Brunswick, N. J., has announced the availability of PSR-2800 triangular guide line **tape** for insulating of form wound motor coils. . . . (60) A new electrical **tape,** called "Scotch" branch No. X-1099, has been announced by Minnesota Mining and Manufacturing Co., 900 Bush Ave., St. Paul 6, Minn.

Catalogs & Bulletins

(61) TRANSFORMERS. Bulletin GEA-6070D gives detailed information on new distribution transformer including cutaway drawings, oscillograms, and load-life curves. General Electric Co.

(62) TERMINAL BOXES for multi-junction thermocouples. Bulletin describes cast iron and sheet steel boxes for protection against oil, dust, dirt, humidity and other contaminants. Thermo Electric Co.

(63) TRANSFORMERS. Bulletin GEA-6126B, 24 pages, covers construction features and operation of line of self-protected distribution transformers rated 100 kva and below. General Electric Co.

(64) CABLES. 44-page catalog covering Compresto aerial cables, service drop and secondary cable, and weather-resistant line wire. Southern Electrical Co.

(65) STATION ARRESTERS. Bulletin GEA-6794A, 12 pages, describes new Thyrite Magnevalve arresters for high and extra-high voltage applications. General Electric Co.

(66) OIL-FILLED CUTOUTS. Bulletin GEA-6825, 28 pages, covers line of cutouts rated 5.2 kv, 100, 200, 300 amps, and 7.8 kv, 100 amps, for fusing and switching operations. General Electric Co.

(67) METER SOCKETS. 4-page product data bulletin No. 140 describes and illustrates new UL-approved raintight sockets with fixed or interchangeable hubs. General Switch Co.

(68) AC TEST SETS. Bulletin GEA-6839, 4 pages, covers console-type high-voltage test sets for dielectric testing of insulation, oil, and apparatus up to 50 kv. General Electric Co.

(69) FLOODLIGHTING. Cast aluminum outdoor floodlights are described in 8-page Catalog S, including illustrations, specifications and dimensional drawings. Stonco Electric Products Co.

(70) FREQUENCY METERS. Frahm meters in miniature, switchboard and portable types in various ranges between 10 and 1700 cps with guaranteed permanent accuracies of plus or minus 0.1% are covered in Bulletin 32-6. James G. Biddle Co.

(71) FUSE CUTOUTS. Bulletin GEA-6208B, 12 pages, gives information on enclosed fuse cutouts rated 5.2 kv and 7.8 kv, 50 and 100 amps. General Electric Co.

(72) CONTROL TRANSFORMER Bulletin 14-BL01 contains quick-reference chart showing percent of rated load and percent secondary voltage drop for control transformers used for intermittent or duty-cycle applications. Acme Electric Corp.

(73) TRAFFIC CONTROLLERS for isolated intersections. Bulletin 2720 lists and describes new series of electronic units with information on traffic signals which may be used with them. Crouse-Hinds Co.

(74) SOLDERLESS CONNECTORS and terminal blocks. 8-page Catalog 85, prepared especially for electrical contractors and maintenance men, features connectors for wire splicing and terminating plus one-piece terminal blocks. Buchanan Electrical Products Corp.

(75) THERMAL ELEMENTS—history, theory and application. 29-page booklet describes origin and operation of snap-acting disc-type thermal elements for actuating thermostats, circuit breakers, and motor overload protectors. Metals & Controls.

(76) LIGHTING FIXTURES. Wall-mounted fluorescent and incandescent Reflectolites for exterior and interior use in commercial, institutional and public buildings. 16-page Folio R-60. Gruber Bros. Inc.

(77) CIRCUIT BREAKERS. Bulletin GEA-6759, 2 pages, gives complete information on new low-impedance breaker rated 5 through 75 amps. General Electric Co.

(78) SOLENOID VALVES. Catalog describes complete line for control of water, oil, steam, air, gas and chemicals. Magnatrol Valve Co.

(79) BUSWAY. Form XL-1 gives specifications of new XL Bustribution duct in sizes to 1000 amps, 50,000 rms short-circuit rating. Bull-Dog Electric Products Div., I-T-E Circuit Breaker Co.

(80) SCREW ANCHORS. 4-page folder also covers toggle bolts, expansion anchors, masonry drills and screw shields. Holub Industries Inc.

(81) POST LIGHTS for residential use. 8-page booklet includes description of Nite Guard photoelectric cell for automatic control. Progress Mfg. Co. Inc.

(82) LIGHT CONTROL. 4-page folder describes new dimmer for control of a 200-watt incandescent load or five 40-watt RS fluorescent lamps. Superior Electric Co.

(83) POWER CABLES for use in underground mining, strip mining and pits and quarries; heavy portable cables for heavy equipment. Booklet WC-8099. General Electric Co.

(84) ELECTRIC HEATERS. Commercial grade heavy-duty baseboard units for schools, motels, churches, offices, apartments, etc., are described in Bulletin F 50100. Edwin L. Wiegand Co.

(85) FLUORESCENT LIGHTING, wall and utility. 8-page booklet introduces Reflect-A-Line and Prismalux bath brackets, outlines specifications for Lyteline and Sightron units. Lightolier Inc.

(86) SYNCHRONOUS MOTORS. Bulletin SS459, 12 pages, describes line of instant starting, stopping and reversing Slo-Syn motors for remote control systems, numerical control systems, and automatic machines and apparatus. Superior Electric Co.

(87) UNIT SUBSTATIONS applicable for both walk-in or standard requirements in ratings from 6900 through 69,000 volts incoming, and from 2400 through 13,800 volts outgoing are covered in 4-page Bulletin S-2701-IA. I-T-E Circuit Breaker Co.

New Books & Pamphlets

Analysis of 1959 Revision of National Electrical Code, by Howard Michener, 50 cents. National Electric Manufacturers Assn., 155 East 44th St., New York 17, N. Y.

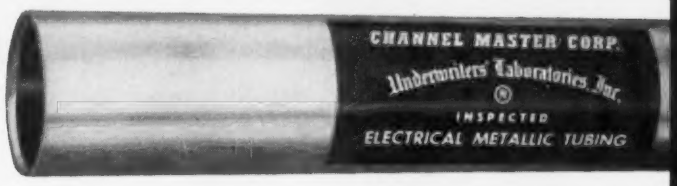
An editorial treatment discussing the Code changes to assist users in comparing the 1956 and 1959 editions.

Lefax Pocket Size Technical Data Books, $1.25 each. Lefax Publishers, Philadelphia 7, Pa.

These handy books cover every field of engineering and are of constant use to engineers, technical men, shopmen, teachers and students. Partial list of loose-leaf books includes power transmission machinery, ac motors and generators, electrical transmissions, electricians data, ac and dc electricity, illumination, transformers, relays and meters, and general mathematics. Free catalog is available.

(*Continued on page* 182)

CHANNEL MASTER ALUMINUM EMT



lightens the load... brightens the job... and never shows its age!

Light-weight aluminum cuts the cost of shipping, storage, and handling. ⅓ the weight of steel. New flat bundle simplifies stacking and storing.

The swing is to ALUMINUM

. . . for faster, better looking installations . . . at lower cost. Available from your regular distributor.

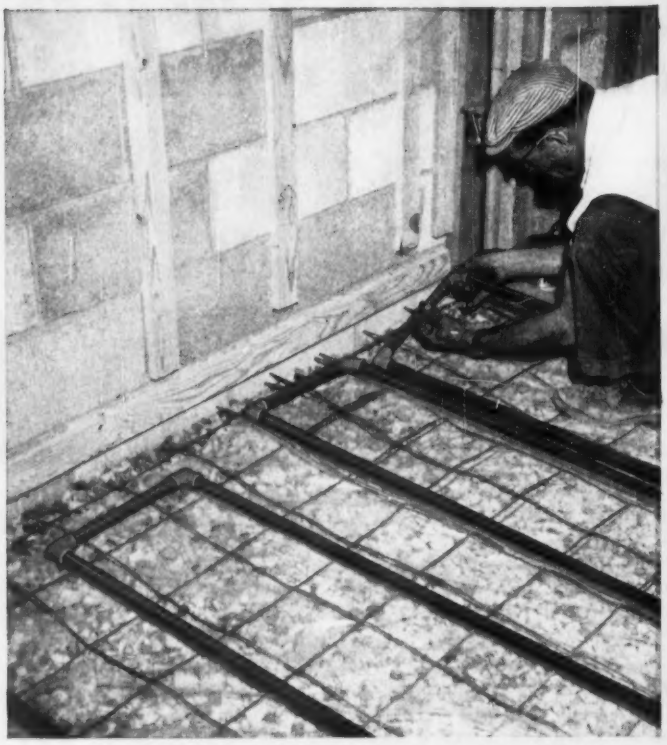
Nothing can take the place of feather-weight ALUMINUM

- ★ Aluminum stays good-looking... mirror bright, mirror smooth... inside and out... won't ever show its age.
- ★ Channel Master aluminum EMT is extruded and drawn, *not* welded: has no seams or "beads".
- ★ Hard-drawn, highly polished, seamless raceway facilitates fishing and wire-pulling.
- ★ Can never rust. Unaffected by water, humidity, and industrial atmospheres.
- ★ Standard inside and outside diameters. Uses standard EMT fittings.
- ★ Speeds up the job. Cuts and bends up to 40% faster. Use on any standard bender.

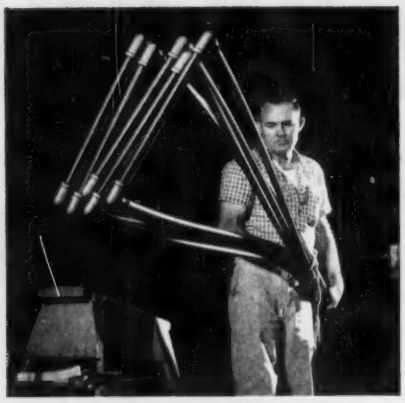
CHANNEL MASTER CORP.
ELLENVILLE, NEW YORK

Naugatuck KRALASTIC®

Rubber-Resin



Installation of KRALASTIC pipe manufactured by Plastic Pipe Division, Triangle Conduit & Cable Co., Inc.



Whole sections are easily prefabricated and carried to site.

Solvent welding speeds and simplifies connections.

Now Kralastic reduces radiant heating costs

PROVED FOR 8 YEARS—1½ MILLION FEET IN USE

KRALASTIC®—the plastic pipe material that has proved so superior in dozens of piping applications—has now made it possible to reduce overall radiant heating costs by an average of 25% ... as much as 25 cents a square foot!

Thoroughly approved by all who have worked with it, including architects, heating engineers, and contractors, KRALASTIC has made radiant heating practical for home buyers and builders everywhere by providing such advantages as these:

- Lower cost than any metallic coil material on the market
- Lightweight toughness that allows whole grid sections to be prefabricated in the shop
- Solvent welding for quick, sure joining on the job
- No need for special expansion joints as with other materials
- Exceptional resistance to clogging
- Complete freedom from rust and corrosion
- Compatibility with standard radiant heating designs and techniques

The more than 145 installations of KRALASTIC for radiant heating give evidence of the advantages you can expect in KRALASTIC pipe for potable water supplies, chemical piping, electrical conduit, waste disposal, applications by the hundreds. Learn first hand the proved advantages this tough rubber-resin material offers *you*. For further information on KRALASTIC pipe, for expert technical assistance with *any* product application, contact us today.

United States Rubber

Naugatuck Chemical Division 134K ELM STREET NAUGATUCK, CONNECTICUT

KRALASTIC RUBBER-RESINS • **MARVINOL** VINYLS • **VIBRIN** POLYESTERS

Akron · Boston · Gastonia · Chicago · Los Angeles · Memphis · New York · Phila. · CANADA: Naugatuck Chemicals · Elmira, Ont. · Cable: Rubexport, N.Y.

Reader's Quiz

QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repairs. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay $5.00.

AC Meter Leads On Switchboards

QUESTION B37—In connecting ac meters on the switchboard, does it affect the accuracy of the meter to splice 4 or 5 ft of wire to the potential and current transformer secondary leads so as to make them reach the meters?—G.J.P.

ANSWER TO B37—Theoretically, a small error would be caused by splicing 5 ft of wire to the instrument transformers so as to reach the meters. Practically, the added resistance of the wire compared to that of a potential coil is insignificant. In the case of current transformers, the added wire resistance plus that of the current coil of the meter must not exceed the allowable "burden" of the CT. In either case it is a good idea to twist the lead wires together to reduce the inductive ohms of the leads.—R.W.K.

ANSWER TO B37—The subject of CT and PT accuracy is too lengthy and complex for treatment in this article. However a clear explanation can be found in a book entitled, "The Art and Science of Protective Relaying", by C. R. Mason, published by John Wiley in 1956.

There should be no problem with the potential transformers, since the impedance of the conductor will be small compared with the impedance of the indicating instrument. The problem lies with connecting too many devices in parallel on one set of PTs.

The equivalent circuit of a current transformer is shown in diagram below.

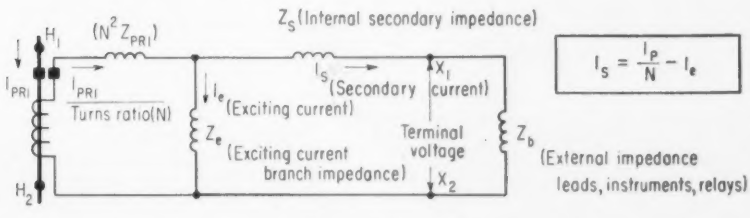
In general, as the secondary burden impedance increases (due to conductor impedance or too many devices in series) a higher voltage is impressed by the CT to circulate the secondary current. This higher CT secondary voltage causes more current to flow in the excitation branch. This in turn changes the effective ratio between the primary and secondary currents and introduces ratio error. This is more important in relay circuits where high fault currents must be considered.

As a practical matter, the effects of 5 or 6 ft of normally sized switchboard wire should have no noticeable effect on the metering accuracy.—L.D.B.

ANSWER TO B37—Assuming wire sizes are adequate and connections are made up tight, it should not affect the accuracy of an ac meter on a switchboard if 4 or 5 ft of wire are spliced between the potential transformer or current transformer secondaries and the meters in question. In the case of the potential transformer, the wire will carry a very low current and any voltage drop in the wire will be negligible. Thus the meter will read voltage with accuracy determined by the transformer and meter involved.

Current transformers are usually sized so that 5 amps of secondary current will produce full scale deflection on an ammeter. The construction of a current transformer is such that the secondary current is independent of the impedance in the secondary circuit provided the impedance is low. The impedance of two 4- or 5-ft lengths of wire of appropriate size will be considerably less than the impedance of the ammeter. Thus the effect of the two wires is negligible and the meter will read current with an accuracy determined by the transformer and meter involved.

It is clear then, that 4- or 5-ft wire leads in the secondary circuits of the transformers should not introduce inaccuracies in either case assuming that all connections are made up tight.—I.F.



Batteries

QUESTION C37—The plant where I am employed is about to make a purchase of a battery-driven pulp handling equipment. It is planned to use storage batteries for this application.

Some engineers say it is best to use lead-acid batteries. Others say the Edison nickel-iron-alkaline storage battery is much better.

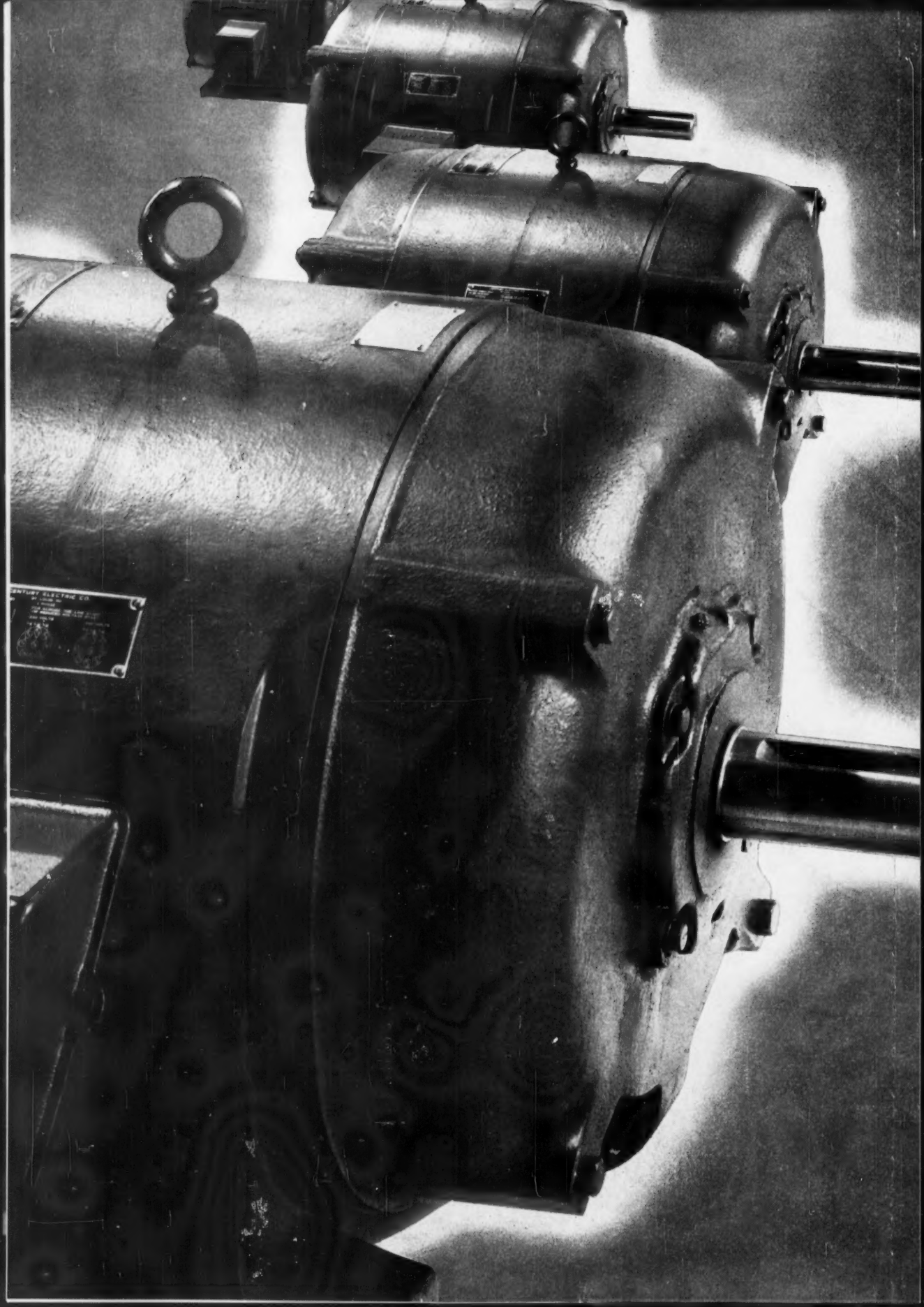
How does the purchase price, efficiency, ruggedness, maintenance, life, weight, size and time required to charge each type compare?—M.D.

ANSWER TO C37—Nickel-iron batteries are the longest lived and most dependable source of battery power. Batteries of this type, while higher in initial cost, in the end offset that cost in terms of their great life and dependability. Nickel-iron batteries require a minimum of maintenance and attention. Unlike the lead-acid type cell, there is no minimum voltage below which the nickel-iron cell must not be discharged to avoid injury. In fact it may be discharged to zero voltage and short-circuited without harm.

The gases evolved in lead-acid cells, oxygen and hydrogen, form an explosive mixture, and care should be taken not to bring an exposed flame or cause spark near the vents. Nickel-iron batteries do not give off such gases.

Because of the fact that the active materials of nickel-iron batteries are enclosed in steel tubes and pockets, gassing incidental to charging cannot dislodge them. Hence, unlike the lead-acid-type cell, it is unnecessary to reduce the ampere rate when the cell is approaching a fully charged condition to avoid rapid evolution of gas. From a practical standpoint this gives the nickel-iron type battery an advantage of obvious importance where the battery must be cycled regularly within the limits of a normal working shift (8 hours).

The nickel-iron cell weighs less per kilowatthour of rated capacity than any of the heavy-duty lead-acid-type cells. Where the battery supplies the power to propel a vehicle, less of its power is consumed in carrying around its own dead weight.—F.W.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1965–26,000,000 horsepower

Conservative estimates place the total horsepower of all motors driving fans and blowers in the United States at about 16,450,000 horsepower. And in 1965 it is estimated that the total will be about 26,000,000 . . . an annual growth of 5% for the air moving industry. To make sure all this equipment gives top performance requires careful matching of motor to equipment . . . and a wide variety of different types of motors. Century Electric application engineers can help you select the right motor for your fans, blowers and allied equipment:

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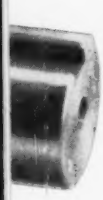
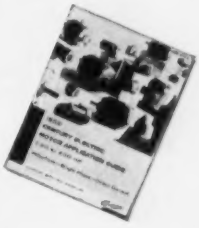
For blowers—If the starting load is light or if there will be short time increases in load, then the Century Electric Type SC polyphase motor is ideal. It will give you enough starting torque, and with low starting current. It comes in ⅙ to 400 hp sizes. If you need two, three or four different fixed speeds while the blower is running, the Century SCM polyphase motor will do the job.

For compressors—Where high starting torque is required to overcome great inertia or backpressure, the Century Electric Type SCH polyphase motor is right. This motor comes in sizes ranging from three to 400 hp and in dripproof, totally-enclosed and explosion-proof enclosures. It also provides the right kind of power to drive reciprocating pumps with high starting torque requirements.

For pumps—Centrifugal pumps, whose torque demands increase with speed, perform best with Century Electric SC polyphase motors. Reciprocating pumps with high starting torque requirements need the SCH. For all types of pumps, as well as for compressors and blowers, Century Electric makes single phase motors.

For special applications—Century Electric makes a variety of motors for specific operating conditions. The shaft-mounted fan motor is designed for unit heaters and evaporators. It comes in ⅓ to 3 hp sizes. Hermetic motors can be built right into a refrigeration compressor unit . . . they are manufactured under rigid quality controls to make sure they are free of contaminants that could damage capillary tubes and valves.





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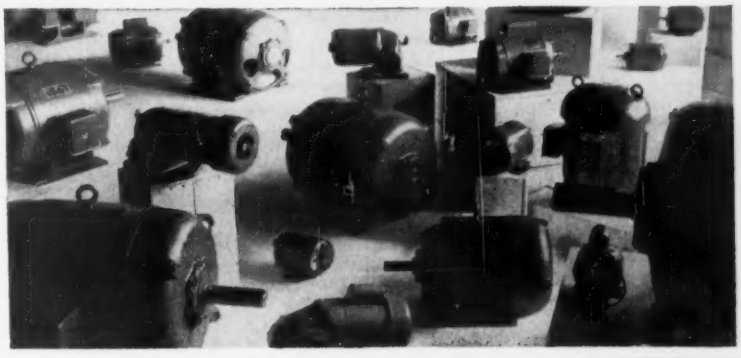

ANSWER TO C37—The answers to these questions will be given in the order in which they were asked.

1. The price of the nickel-iron battery is perhaps a little less than twice that of a lead acid battery of comparable rating while the nickel-iron-cadmium (also an alkaline type) battery might cost nearly three times as much.

2. The efficiency (ampere hour basis) of a lead acid battery runs from 85%-90%, while the alkaline type of battery has an efficiency in the range of perhaps 80%. When viewed as a part of the overall picture including maintenance and life expectancy the lower efficiency of the alkaline battery is not of great significance, particularly so if electrical energy rates are reasonable.

3. The alkaline battery is much more rugged than the lead acid battery. It will stand more abuse in nearly every respect—higher temperature operation, no damage from freezing, complete discharge, accidental short circuiting, etc.

4. There is very little maintenance required of an alkaline battery—keep cells filled just over the elements with distilled water and keep clean and dry to avoid current leakage. The lead acid would require somewhat more maintenance.

5. The life of a storage battery for motive power use might run five years on a lead acid type and ten years, and in some cases, as high as 20 years for the alkaline type.

6. Lead acid batteries will weigh perhaps in excess of 10% more than the "Edison" type battery.

7. The nickel-iron-cadmium battery would be approximately the same size, and the nickel-iron type is somewhat larger than the lead battery.

8. The time to charge the alkaline battery is somewhat greater than for the lead acid type for a comparable size. The type of charger can be any one of several: rectifier, motor-generator, etc. The nickel-iron-cadmium type of charger would be slightly larger, and the cadmium-iron about the same size as the acid battery charger.—T.M.S.

Paralleling Transformers

QUESTION D37—What conditions must be met for satisfactory operation of distribution transformers in parallel? What effect will the transformer constants have?—J.A.M.

ANSWER TO D37—When operating transformers in parallel, a number of conditions must be met:

First, for transformers in parallel the ratio of the voltages high to low must be exactly the same. If this is not the case, some current will flow in the parallel at no load and as the load is added the transformers will not divide the load as they should. If the bank is a step down bank, the transformer with the lowest voltage ratio (the highest secondary voltage) will carry the greater part of the load. Even with transformers with the same full winding ratio the taps may not be the same fraction of the winding and so on taps the transformer can circulate current at light loads and run unbalanced at full load.

Second, if the ratio is the same in both transformers, the load currents can be unbalanced by the differences in impedances of the two transformers. This point is somewhat involved. In general, for large transformers the impedance is given in percent. This is the percent of the energized winding rated voltage needed to pass full load current through the energized winding, in a two winding transformer, with the other winding shorted. The power factor of this circuit is not stated. Therefore, one does not know the resistance drop or reactance drop. All one knows is that the two combine to give the stated voltage at full load current.

The part of the whole drop caused by these two factors can vary a great deal from transformer to transformer. The transformer is built so that on short circuit the windings will not be broken. If the unit is small the copper is small and the resistance is higher than in the larger unit; therefore, the reactance can be lower and leave the transformer self protecting. The small coils and currents would have less leakage flux and less reactance. Paralleling different size transformers leads to unbalance.

The two parts of the impedance each cause a drop in voltage in a fixed time relation with the current. The resistance has a voltage drop in time phase with the total current in the transformer; and the reactance causes a voltage drop that is out of time phase or leads the current by 90 electrical degrees. The high voltage on both transformers is the same and the low voltage is also the same for both step down units. Therefore, the drop in the transformer must be the same. It follows then if the resistance and

reactance is different for the two transformers, the currents cannot be the same.

It may help to think of the problem a little differently. The power current causes a drop that is different in time phase to that which the wattless current causes. So it is about true to say that transformer with the lowest resistance will carry more than its share of the power current, and the transformer with the lowest reactance will carry the greater fraction of the wattless current. At one value of power factor the transformers can be carrying the correct proportions of the current if the transformer currents are used to determine the ratio. In this case the load current will be less than the sum of the two currents.

If you have the banks connected and under load there is little you can do if the resistances are off, but corrective action is possible if the high current unit is high because of low reactance. This is accomplished by clamping a split laminated core over the high current low reactance transformer lead and vary the air gap in the steel magnetic circuit until the balance is satisfactory. It must be said that the reactive power current through the resistance causes a voltage drop; also the power current through the reactance of the winding causes a voltage drop. These voltages tend to shift the secondary voltage out of phase with primary voltage. For lagging reactive load, the two voltages above are in opposite direction and the phase shift is the result of the difference, not the sum, of the drops.

A word on current measurements where units are operated in parallel is in order. For very short parallels like two cables in parallel for transformer leads, the current indicated when only one wire is used for measurement will be below that flowing in the other parallel cable. To prevent this error, it is best to use a number of ammeters so that the instrument load on both is nearly equal.

To summarize, the winding ratios must be exactly the same, even on taps. Check this by measuring the transformer currents at no load. The transformer winding resistance must be the same (if the units are the same size) or proportional if units are not same capacity. The same is true of the reactance of the two parallel units. Connections can be arranged to add resistance or reactance when needed to change the unit's current toward correct values.—G.J.F.

Can You Answer These QUESTIONS?

QUESTION L37 — We've recently have had a lot of trouble with one of our motor starters. Starter is a 7½-horsepower combination type motor contactor and fused disconnect. We have been having trouble with the starter not dropping out when the stop button is pushed. This doesn't happen all the time, but happens enough to give us considerable trouble. This motor operates a feeder to a conveyor belt so it is important that the feeder shut down when the belt stops. We suspect it is due to the control cable having an induced voltage in it, causing it to hold the starter in. The pushbutton and interlock are connected to the starter with 1000 ft of 3-wire tirex cable strung on a messenger cable. The power cable for the starter is also strung on the same messenger and is a four wire tirex cable. There are also a number of other cables of the same type strung on this messenger supplying other feeders. I would appreciate some advice on how to cure this trouble. —E.T.

QUESTION M37 — In our quarry operation, we have a problem in maintenance of our shovel 2300-volt trailing cable.

In moving from location to location, the cable is frequently subjected to breaking strains.

Our problem then is to locate breaks in the cable which would not be evident on the surface. At present, we cut the cable at a splice and test both ways.

We would like some method using an explorer coil and earphones which would exactly locate the trouble.—V.W.B.

QUESTION N37 — I have a customer who has an air compressor that runs much of the time. It is causing a flicker on the lighting in the near portion of the building. Would a capacitor connected to the circuit near the motor eliminate this flicker?

The motor is ¾ hp, 115/230 volts, 1.6/3.8 amps, currently connected for 115-volt branch circuit operation.

If the above is practical, what size capacitor would be correct? —L.E.M.

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Other exclusive features will create instant sales appeal with builders and homeowners. New Adjust-O-Matic* control automatically maintains room temperature to within 2° of setting. Special safety features include built-in thermal protection, and a baffle providing low surface temperatures comfortable to the touch . . . despite the high output of 250 watts per foot.

Here is the electric baseboard that has been designed to satisfy your customers and build higher profits for you. Have your builder see the Westinghouse all-new Electric Baseboard at the NAHB show, January 17-21, Chicago. Write now for complete specifications and application data, Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

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Questions on the Code

Answered by:

B. A. McDONALD, *New York Board of Fire Underwriters, Rochester, N. Y.*
B. Z. SEGALL, *Consulting Electrical Engineer, New Orleans, La.*
R. E. WARD, *Chief Electrical Inspector, Insurance Department, State of Tennessee, Nashville, Tenn.*

Services Exceeding 600 Volts—Transformer Protection

Q. *Below are a number of questions I would like answered. This problem is quite involved but it appears quite often and I do not believe that very many people know the answers. I don't know the answer myself.*

Case 1. *At Point A no overcurrent protection and disconnecting means are provided (Sec.* 2392). *According to an old edition of Abbott's Handbook the OCB is set according to Section* 2403 (150% *max). Does this mean that when a breaker is installed at point A then the OCB is set according to Section* 4512 (250%)? *Couldn't there be nuisance tripping when OCB is set at* 150%?

Case 2. *When point A becomes A-*1 *and A-*2, how do Sections 2392, 2403 *and* 4512 *apply in order to meet minimum code requirements?*

Will you please go into detail to explain how Case 1 *and* 2 *are effected when coordinated thermal overloaded protection is provided in the transformer.*

What are the various methods used by the manufacturer to obtain coordinated thermal overload protection? Does a transformer have to have this and how do you tell when a transformer has such protection? Is this shown on the nameplate?—H.S.

A. Case 1: For the convenience of our readers, the provisions of Section 2392 (230-104) reads as follows:

"EQUIPMENT IN SECONDARIES. If the primary service equipment supplies one or more transformers whose secondary windings feed a single set of mains, and the primary circuit breaker is manually operable from a point outside the transformer vault, the disconnecting means and over-current protection may be omitted from the secondary circuit, provided the setting of the primary circuit breaker is such as to protect the secondary circuit. In all other cases the secondary circuit shall be provided with a disconnecting means and overcurrent protection as required by various paragraphs of this article."

It is significant to note that this code rule, which applies to services exceeding 600 volts, is an exception, whereby the primary service circuit breaker may serve to protect the secondary conductors, provided the setting of this circuit breaker is such as to protect the secondary circuit. In other words, we have an exception to a fundamental rule which requires protection on both the primary and secondary of the transformer. A question immediately arises concerning the phrase "provided the setting of the primary circuit breaker is such as to protect the secondary circuit."

According to the provisions of Section 2403-C "Adjustable-trip circuit breakers of the thermal trip, magnetic time-delay trip or instantaneous-trip types shall be set to operate at not more than *150% of the allowable current carrying capacity of the conductor."

According to the latest edition of Abbott's N. E. Code Handbook, this rule applies to the secondary conductors of the case under discussion. In order to clarify the application, the following example is given by Abbott.

Assuming a primary voltage of 2,300 volts and a transformer supplying a single-phase, 3-wire, 115/230-volt load of 100 kva, the secondary current would be 435 amps, requiring 700,000-cir mil conductors if type RH conductors are used. The current capacity of the secondary main is 460 amp, and since the primary current will be one-tenth of the secondary current to comply with Section 2403, the primary breaker, if of the adjustable-trip type, should be set to open at not more than *150% of 46 or 69 amps.

This concept of the code rules involved appears to be correct since the ratio between primary and secondary current should be established so that the phrase "provided the setting of the circuit breaker is such as to protect the secondary

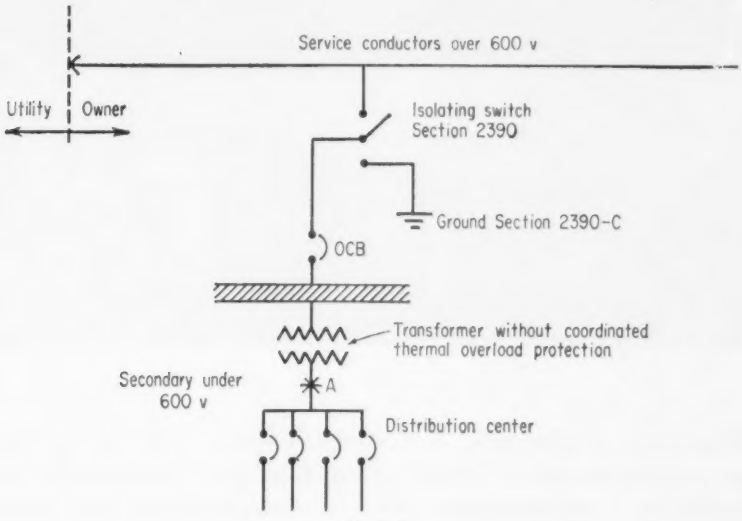


Fig. No.1

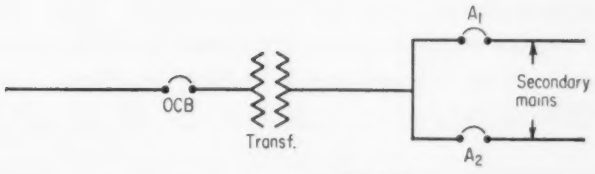
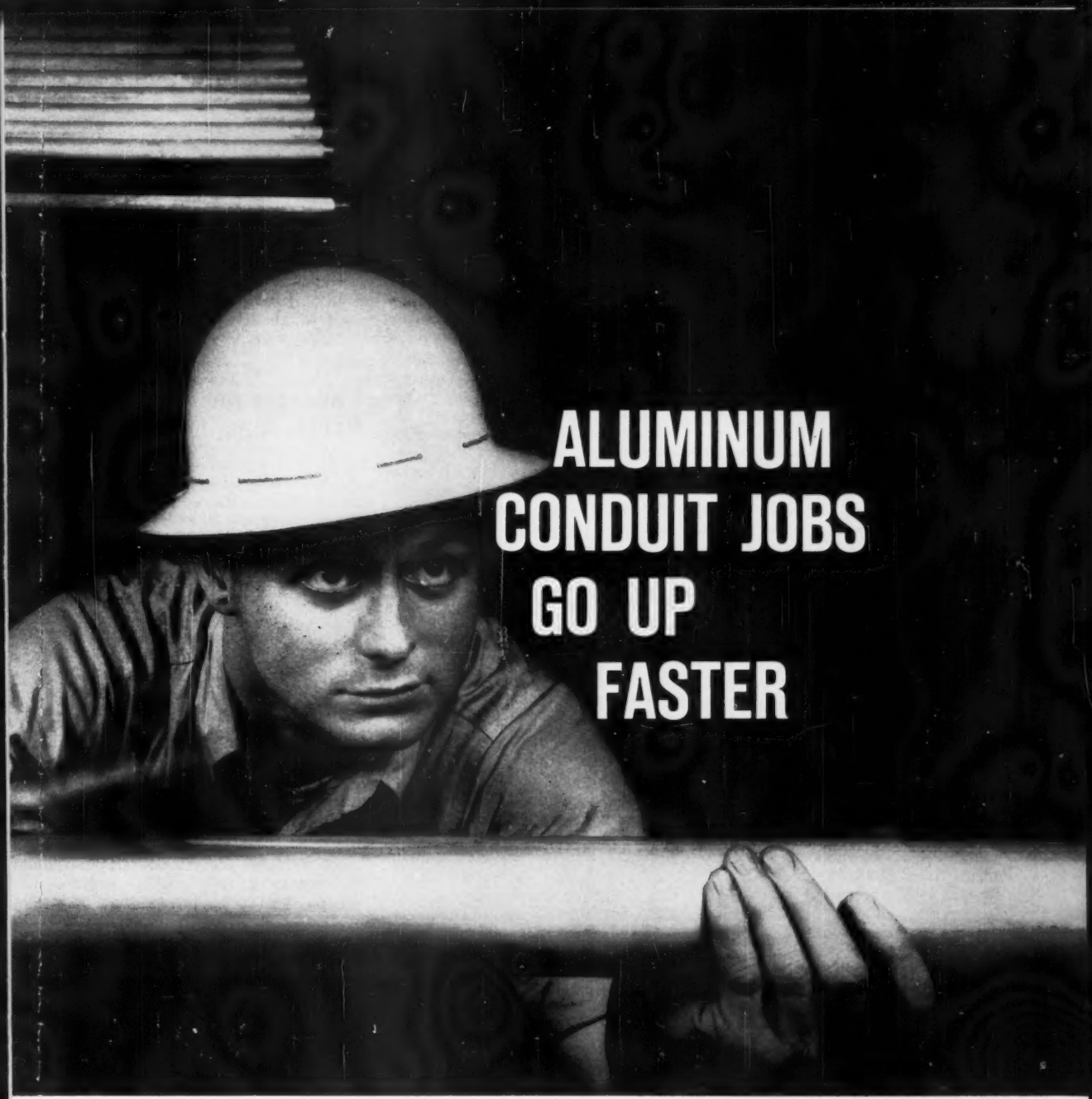


Fig. No.2

HERE'S WHY:

Light weight—weighs only ⅓ as much as steel . . . **easier to handle** regardless of the job . . . **easy to cut, bend and thread,** and without special tools . . . **competitive in price . . . nonsparking** for safer installations . . . no special nonsparking tools required . . . **corrosion resistance** means no maintenance under normal service conditions . . . **color coded** for fast, accurate size identification. **Approved by Underwriters' Laboratories, Inc.** . . . and it's **available from local distributor stocks** for fast, dependable delivery.



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circuit" is satisfied. If secondary conductors larger than required are used, the breaker setting may be larger.

If a circuit breaker is installed on the secondary of the transformer at point (A) shown on the diagram, it could be set at not more than 250% of the rated secondary current of the transformer. This rule concerns the overcurrent protection of the transformers and not the conductors. Under such circumstances the setting of the service circuit breaker would not be limited to *150% when it is used to protect the secondary conductors of the transformer. Under such conditions the transformer is protected from overload by a circuit-breaker in the secondary, set at not more than 250% of the rated secondary current of the transformer. Under such circumstances, it appears to me that the conductors in the secondary circuit must be of a size not smaller than the 150% protection required by Section 2403-c. In other words, the transformer may have 250% protection, and the conductors must be sized to have 150% protection. The same reasoning appears to apply to the primary service circuit breaker, as covered by Section 4512-a, and the exception of 4512-b.

*Section 240-5, exception No. 2 of the 1959 Code changes the maximum setting of adjustable-trip circuit breakers to 125%.

CASE 2: In the case shown by Fig. No. 2 the transformer is protected by the circuit breaker in the primary, and the two secondary mains are each protected by circuit breakers set or rated in accordance with Section 2403-b or c. The starting current of motors may affect the rating. Under such circumstances Section 2392 is not involved. Section 4512-b, which concerns transformers equipped with coordinated thermal overload protection, appears to be involved. This provision reads as follows:

"Primary and secondary. A transformer having an overcurrent device in the secondary connection, rated or set at not more than 250% of the rated secondary current of the transformer, or a transformer equipped with a coordinated thermal overload protection by the manufacturer, is not required to have an individual overcurrent device in the primary connection provided the primary feeder overcurrent device is rated or set to open at a current value not more than six times the rated current of the transformer for transformers having not more than 6% impedance, and not more than four times rated current of the transformer for transformers having more than 6% but not more than 10% impedance."

It is difficult in an article of this nature to cover the many details involved with this rule. Reference to Abbott's N. E. Code Handbook 1953 and 1956 editions, clearly covers by illustration, comment and example, the application of transformers having coordinated thermal overload protection. Since any comment by me would be a repetition of Abbott, I suggest that you consult this book for the details involved. He also explains the theory of "coordinated thermal overload protection."

Segall's "Electrical Code Diagrams" also explains, in considerable detail, a transformer equipped with such protection. A wiring diagram of the various components is shown, and also examples of correct application. I suggest that you consult this book for the many details involved.—B.A.McD.—1/60/1

Multi-Wire Branch Circuits

Q. *What does the inspector mean where a multi-wire branch circuit consisting of two ungrounded and one neutral wire is used when he states on a rejection: "You are doubling up on the neutral conductor."?—D.B.*

A. Section 210-4 states:

"Multi-Wire Branch Circuits. Branch circuits recognized by this Article may be installed as multi-wire circuits. A multi-wire branch circuit as referred to herein is a circuit consisting of two or more ungrounded conductors having a potential difference between them, and an identified grounded conductor having equal potential difference between it and each ungrounded conductor of the circuit and which is connected to the neutral conductor of the system."

You will note from the above section that ungrounded conductors have a potential difference between them. I am of the opinion you have connected your ungrounded conductors of the multi-wire branch circuits to the same bus bar or side of the line in your panel or service equipment. In so doing you will not have a potential difference between ungrounded conductors and your neutral will have to carry the total load of the two ungrounded conductors.—R.E.W.—1/60/2

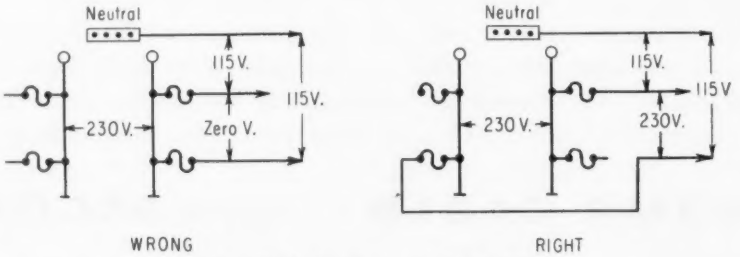
Underground Feeder Cable

Q. *I plan on using underground feeder cable to a yard light in my lawn. Where the cable is buried there will be no driveway or other heavy traffic over the buried conductors. At what depth shall I bury the cable to meet code requirements?—H.M.B.*

A. The answer to your question is not covered in the National Electrical Code. Some manufacturers of UF cable recommend certain depth burial of their product. For your information I suggest you contact your local authority as to the requirements in your locality as requirements vary in different localities due to make-up of the earth (rock, etc.). I also suggest that you read Article 339 of the 1959 National Electrical Code and Sections 310-6 and 230-32(a), which govern the code installation of UF or USE cable.—R.E.W.—1/60/3

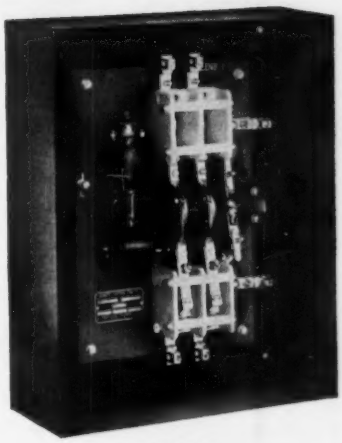
Welder Circuit— 4 Conductors in Conduit

Q. *Does the code permit the installation of four 500 MCM conductors, serving a resistance gun welder, to be installed in one 3½-in. conduit as shown in illustration? Two separate 3-in. conduits could be run but it will make a*



Use of multi-wire branch circuits. Section 210-4

IMMEDIATE FULL LIGHTING INTENSITY IN TRANSFORMER-TYPE DIMMER INSTALLATIONS with ASCO double throw mechanically held remote control switches . . .>



APPLICATION

In theaters and auditoriums using dimmer controls to provide smooth and gradual control of the lighting intensity, a means of furnishing full lighting in an emergency is essential. The ASCO Bulletin 915-175 Remote Control Switch provides this full lighting – immediately – regardless of the dimmer position. Control stations conveniently located to responsible attendants permit full control of lighting under emergency and possible panic conditions.

Why Double Throw?

Where rheostatic devices are used as the dimmer means, single throw switches can be used to shunt around the dimmer. However, where transformer type dimmers are employed, the dimmers cannot be shunted. Instead they must be by-passed – in effect, isolated – when an emergency occurs. This necessitates a double throw switch.

Why Mechanically Held?

A switch in this "sensitive" position must be unaffected by line voltage conditions; hum or chatter would be intolerable.

Mechanically Held ASCO Remotes meet these requirements. These switches are *not* affected by line voltage conditions. The coil is momentarily energized during the instant of operation only. Contacts are firmly locked in place by the angular position of the linkages. Results: No Hum–No Chatter – *These Switches Respond Only To Push Button Control.*

CIRCUIT DIAGRAMS

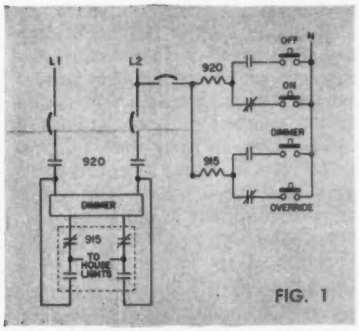


FIG. 1

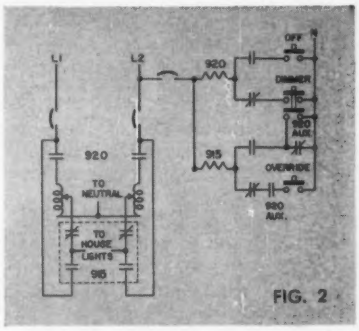


FIG. 2

In the circuit of Figure 1, the Bulletin 920 Switch is used in the conventional manner in the main line. The dimmer control circuits, including the Bulletin 915 double throw Switch are picked off the load side of the Bulletin 920. The Bulletin 920 Switch provides on-off control. The Bulletin 915 double throw Switch provides dimmer by-pass control. Should it be necessary to have full illumination, depressing the "over-ride" button by-passes the dimmer control.

Obviously pressing the "dimmer" button again places the transformer in the circuit. Additional control stations can be added by parallel connections.

An unusual contact arrangement is shown in Figure 2. When the Bulletin 920 Switch is thrown to the "Off" position, the dimmer switch (Bulletin 915) automatically operates to the "dim-light" position. This is accomplished through the use of auxiliary contacts on the Bulletin 920 Switch.

ELECTRICAL SPECIFICATIONS

- **Rated in amperes per pole for non-inductive load to 250 volts A-C**
- **Standard listings in capacities from 30 to 200 amperes**
- **Suitable for tungsten lamp load, fluorescent, and all other types of lighting loads**
- **Interrupting capacity 150% of rated current**
- **Thermal capacity not less than 20 times rated current**
- **Barriers on all poles**

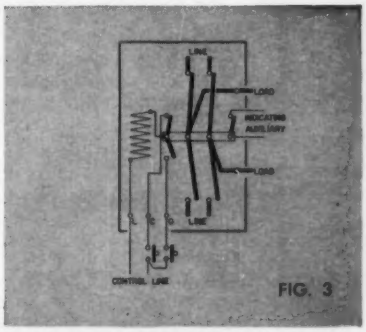


FIG. 3

ELECTRICAL CONNECTIONS. Wiring diagram of Bulletin 915-175 Remote Control Switch. Note control circuit is arranged for 3 wire push button control.

For complete information on ASCO Remote Control Switches for lighting and mixed loads, write for Switch Catalog 57S-2 or have the ASCO Engineer call.

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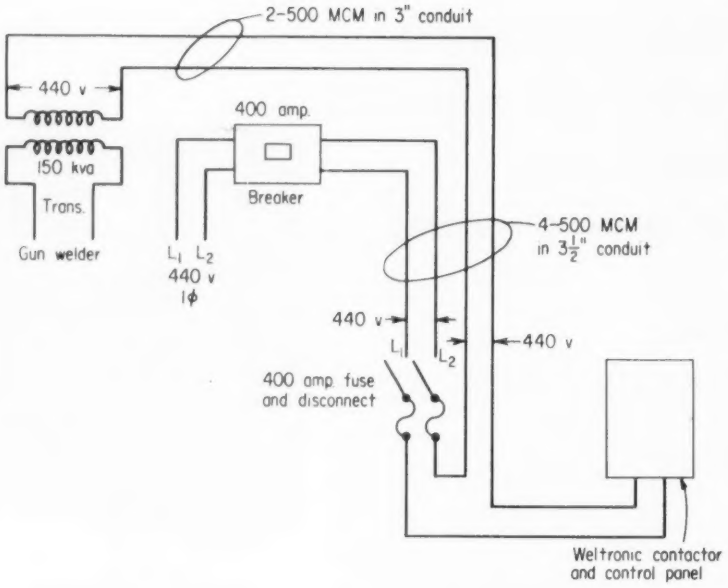


great difference in the cost of the installation.—W.J.D.

A. I am unable to find any code provision which would deny the use of the procedure shown by your illustration. In view of the fact that there would be four conductors in the 3½-in. conduit, note 4 following Tables 1 and 1A (note 8 of Tables 310-12 to 310-15, 1959 Code) would apply. As a result, the current-carrying capacity of a 500 MCM, Type RH copper conductor would be reduced from 380 amps to 304 amps, or a Type R conductor of the same size would be reduced from 320 amps to 256 amps. When this factor is considered it is quite possible that the difference in the cost between the two methods of procedure will not be as great as anticipated.—B.A.M.—1/60/4

Conductor Clearance Over Roofs

Q. *This is an inquiry as to the interpretation of the contents in Section No. 2322-A Article No. 230 and Section No. 7324 Article No. 730.*

Does the 8-ft clearance apply to conductors passing over the entire roof of the building? I would also appreciate having the term "readily walked upon" explained. Supposing one would have a flat roof building but you would have to obtain a ladder to get on to the roof, would this be considered "readily walked upon"?

Or take for an example, you have a two-story building and from the second floor you have a door opening directly on to the roof of the first story. There is no need to obtain a ladder, one opens the door and walks out on the roof. No doubt: readily walked upon.

Would both examples be considered "readily walked upon"? Webster defines the word "readily" without delay or objection. Would having to obtain a ladder to get on the roof be considered an objection? —A.Z.

A. The provisions of Section 2322-A of the Code (Secton 230-24a of 1959 Code) reads as follows:

"Service drops shall not be readily accessible and for voltages not in excess of 600 volts, shall conform to the following: subsections "a," "b," and "c."

a—Clearance Over Roof. Conductors shall have a clearance of not less than 8 ft from the highest point of roofs over which they pass, except where the voltage between conductors does not exceed 300 and the roof cannot be readily walked upon, the clearance may be not less than 3 ft."

According to Abbott's N. E. Code Handbook, the phrase "roof cannot be readily walked upon" is generally understood to mean a roof which has no access except by the use of ladders or scaffolding. I am inclined to disagree with this concept of the phrase. To me a roof, which cannot be readily walked upon, is one with sloping sides, or a combination of sloping sides and ends such as a hip roof, and I do not believe that the question of access to the roof is involved.

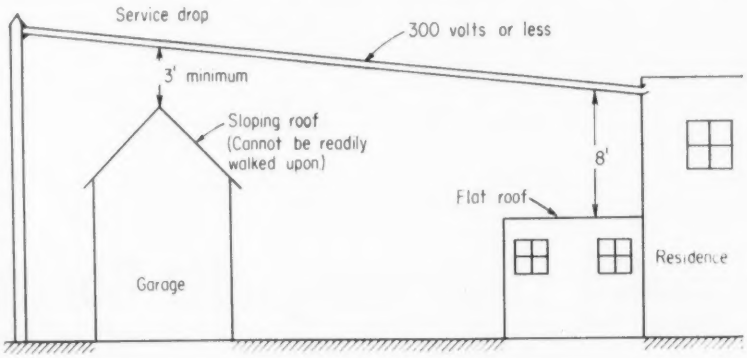
In order to clarify my personal concept of the rule involved, I have shown by illustration a service drop which serves a residential occupancy. It passes over a garage with a sloping roof, and a one story section of the residence with a flat roof. The minimum clearance over the garage roof is 3 ft, and the minimum clearance over the flat roof of the residence is 8 ft. I believe this concept applies regardless of accessibility to either of the two roofs. Official Interpretation No. 400, issued May 18, 1954, appears to verify this opinion. It reads as follows:

"Secton 2322. Clearance of Conductors Over Roofs.

"Question No. 1: In a building with a flat roof with no ready access such as by means of a permanent ladder or a scuttle hole, would service conductors operating at a voltage between them not in excess of 300 volts meet the intent of paragraph a of Section 2322 if they had a clearance of 3 ft from the roof?

"Answer: No.

"Question No. 2: In a building with a flat roof, but with a scuttle hole and permanent ladder attached to the wall adjacent to the scuttle hole, would a 3 ft clearance of service conductors operating at a voltage between them not in excess of 300 volts, be in compliance with



paragraph a of Section 2322, where only maintenance personnel would have reason to work on the roof?

"Answer: No."

A literal reading of this interpretation indicates to me that service drop conductors passing over a a flat roof, regardless of the means of access to the roof, cannot be installed 3 ft above the roof. As a result, they must be installed 8 ft above the roof as shown by sketch, and required by Section 2322-A (230-24a). A flat roof which is accessible through a door or a window is an invitation to the occupants of a building to use same to get a suntan or to dry the washing. Under such circumstances, a service drop installed 3 ft above the roof would be a hazard. A flat roof, which is not so readily accessible, is likewise hazardous to the various types of maintenance personnel essential to the upkeep of the building. The roofer, the carpenter, the painter are some of the tradesmen who would find a service drop 3 ft above a flat roof a hindrance to their activities and a source of hazard when not recognized. To recognize a 3-ft clearance over a flat roof, under most circumstances, would be rash, and I don't believe that the code ever intended such use. O. I. No. 400 appears to justify this opinion.

Your question with respect to the 8-ft clearance applying to conductors passing over the entire roof of a building provokes speculation. The ranch-type of dwelling has presented a problem in connection with the provisions of Section 2322-A (230-24a). Such dwellings often are provided with telescope-type services which extend through the roof of the building to a height sufficient to maintain the required clearances above the ground. In some instances they extend through the eaves, which may be 5 ft in width, a distance above of 2 or 3 ft. Under such circumstances the minimum clearance above the entire roof is not satisfied. Such installations however have been accepted by inspection authorities as satisfying the intent of the code.

Your inquiry and my concept of the rule indicates that the provisions of Section 2322-A (230-24a) should be clarified.—B.A.McD.—1/60/5

Service Equipment

Q. *I am preparing plans and specifications for the electrical work for a masonry church building. The question has arisen concerning location of service equipment. I would like for this equipment to be located near a doorway used as the custodian's entrance to the basement, such entrance being approximately 50 ft from the location where the electric service will enter the building. Is any method approved for such an installation other than placing protective equipment or disconnecting means at the nearest readily accessible location to the service conductors?—F.V.*

A. Yes. Reference is made to Section 230-70(b), 1959 National Electrical Code, which states:

"Location. The disconnecting means shall be located at a readily accessible point nearest to the entrance of the conductors, either inside or outside the building wall. See Section 230-45."

Section 230-45 states:

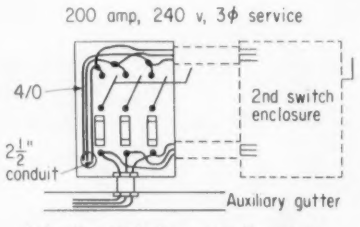
"Conductor Considered Outside Building. Conductors in conduit or duct placed under at least two inches of concrete beneath a building, or buried in two inches of brick masonry or in concrete within a wall, shall be considered outside the building."

From the above you will note that if you can meet the conditions of Section 230-45 with your run of conduit or duct to your service equipment, such installation will meet the requirements of the code.—R.E.W.—1/60/6

Switch Enclosures as Raceways

Q. *Is it permissible to run service wires adjacent to the fuse clip and switch blade blocks inside a service disconnect, for that matter any disconnect? See illustration below. This was done to keep outside meter at limit of 6 ft maximum from grade, and to keep inside service equipment a reasonable height from floor.*

An inspector told me that I was using the disconnect as a raceway. Where in the code may one find such a rule? The only reference that remotely touches on this situation is 93732-4C and D. The definition of a raceway is far different from my problem.—E.R.S.



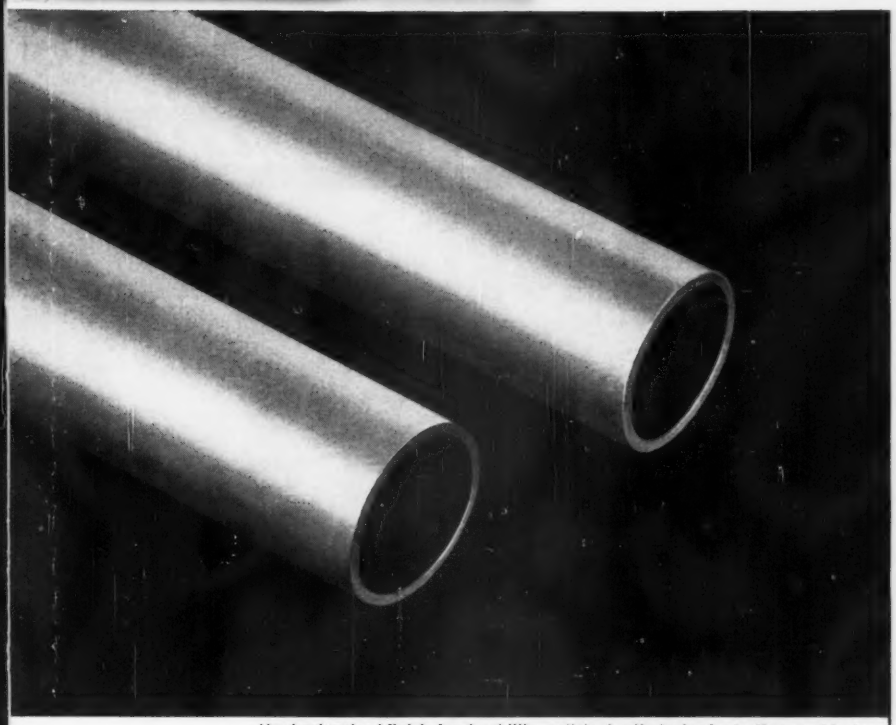
Note the conductor congestion when taps or splices are made, as shown, in the service switch enclosure.

PAST PRESIDENT of the eastern section IAEI, M. C. O'Rourke, Waterbury, Conn. (left) and Clem Lombardi, Woodbridge Electric, electrical contractors. Woodbridge, Conn., enjoy a conversation between sessions at the eastern section 35th annual meeting at Spring Lake, N. J.

A. The provisions of Section 3737-b of the code (Section 373-8, 1959 Code) reads as follows:

"Switch enclosures shall not be used as junction boxes, troughs or raceways for conductors feeding through or tapping off to other switches, unless special designs are employed to provide adequate space for this purpose."

It is significant to note that the rule is applicable when the conductors feed through, or are tapped to serve other switches. According to your diagram the service entrance conductors enter the switch enclosure, and after passing through the combination switch and fuse leave the enclosure, as a feeder, to serve the load. It is also important to note that the rule does not apply when there is adequate space to accommodate the additional wiring involved when taps or splices are made to serve other switches. Conventional enclosures for switches usually are designed to only accommodate the conductors involved with the use of the switch. There is no spare room for other conductors. I have added to your diagram, by dotted lines another switch which the rule intends to cover. It is quite evident in this case that the service switch enclosure is used as a junction box and a raceway to serve the additional switch. There is, in my opinion, no code violation involved with the service equipment installation shown by diagram as submitted by you.—B.A.McD.—1/60/7



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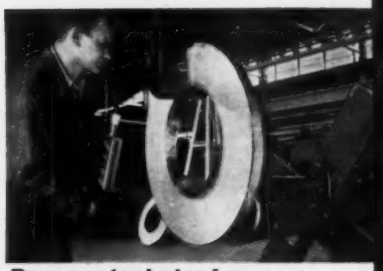

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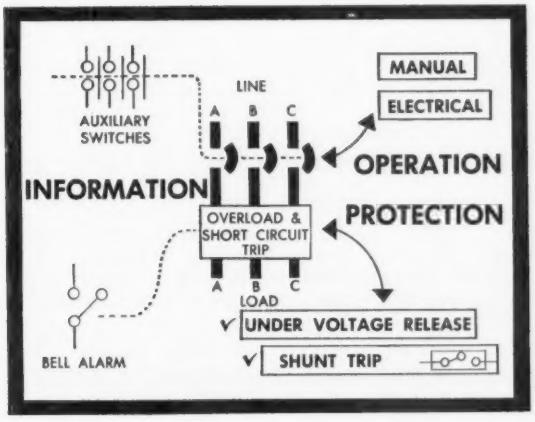

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TAXES

Lower Your Taxes Through Trusts

Despite present high income tax rates, you may be able to save important tax dollars by creating a trust. Here's one way of doing it.

By

Edward S. Schlesinger, *Attorney*

and

Herbert M. Fisher, *C.P.A., Chicago, Ill.*

ALTHOUGH trust funds are usually thought of as something just for rich men's children, trusts have now developed an important place in the tax planning of many far sighted businessmen.

The easiest way to understand a trust is to think of it as an arrangement in which one person (called the Trustee) holds property for the benefit of another person (called the Beneficiary) in accordance with the directions given to the Trustee by the person who created the trust (called the Grantor). You may think of a trustee as the manager of trust property who must follow the instructions given to him by the Grantor in the Trust agreement. No particular amount of money or property is needed to create a trust, and any adult competent to transact business may be a Trustee.

The hypothetical case history of an electrical contractor, whom we will call George, shows how large tax savings would result from the use of a trust. Assume that George, a married man with two children, had built up his own contracting business which netted him $35,000 a year before taxes. In addition to the income from his business, George had managed to accumulate stocks which paid him another $5,000 a year in dividends, to bring his total income to $40,000 a year. Out of this $40,000 George would have to pay $12,400 a year in Federal income tax, leaving him with a net of $27,600.

Softening the Bite

George wanted to find some way of reducing the terrific bite that taxes were taking from his annual income, better than $12,000 out of the $40,000 he was earning. After discussing the problem with his attorney and accountant, George was convinced that he could save himself important tax-dollars by creating a trust. Since he felt he could temporarily do without $4,000 of his yearly dividends, he accepted his attorney's recommendation to

TABLE I—WITH TRUST

Year	(1) Dividend Income	(2) Income on Accumulation (4% of Column 6)	(3) Total Income (Column 1 plus 2)	(4) Income Tax	(5) Total Income After Tax (Column 3 minus 4)	(6) Accumulation (Column 6)
1	$4,000	$.....	$4,000	$807	$3,193	$3,193
2	4,000	127	4,127	835	3,292	6,485
3	4,000	259	4,259	868	3,391	9,876
4	4,000	395	4,395	903	3,492	13,368
5	4,000	535	4,535	940	3,595	16,963
6	4,000	678	4,678	977	3,701	20,664
7	4,000	826	4,826	1,016	3,810	24,474
8	4,000	979	4,979	1,055	3,924	28,398
9	4,000	1,136	5,136	1,096	4,040	32,438
10	4,000	1,298	5,298	1,138	4,160	36,598
Totals:	$40,000	$6,233	$46,233	$9,635	$36,598	

put stocks producing that amount into a trust. George selected his accountant as Trustee. The terms of the trust required the Trustee to accumulate the trust's annual income for a period of ten years, and to invest the accumulated earnings. At the end of the ten-year period, the Trustee was directed to pay all of the accumulated income to George's wife, and to return to George all of the stock which he had originally put in the trust. Thus, after ten years, all of the accumulated income of the trust would be paid to George's wife, and George would get back the stock he had put in trust.

As a result of creating this trust, George increased his family's wealth by more than $14,000 of additional after-tax dollars.

The trust was created in order that the Trustee would pay taxes in the 26% tax bracket on the income received by the trust, rather than George having to pay taxes in the 50% tax bracket on the same amount. Thus, instead of George paying $2,000 in taxes on the $4,000 of dividends in the first year after creating the trust, the trust paid only $807 in taxes on those dividends. It should be noted that the creation of the trust involved a taxable gift for Federal Gift Tax purposes, but it is possible that no gift tax would be payable.

Significant Savings

The following tables illustrate the tax savings accomplished by creating the trust.

Table I shows the amount of taxes paid and the amount left after taxes where the trust was created.

Table II shows the amount of taxes which George would have had to pay, and the amount of after-tax dollars which he would have left if the trust had not been created.

Table III shows the tax savings which George would have made by creating the trust if his taxable income had been $75,000, $60,000, $40,000 or $30,000.

As you can see, at the end of the first year, the trust had $3,193 of accumulated income, and we assume that the Trustee invested this money to earn 4% per year. Thus, in the second year after creating the trust, the trust would still have its $4,000 of dividend income plus $127 in interest on the first year's accumulation of $3,193. Following this pattern for the ten-year period

TABLE II—WITHOUT TRUST

Year	(1) Dividend Income	(2) Income On Accumulation (4% of Column 6)	(3) Total Income (Column 1 plus 2)	(4) Income Tax	(5) Total Income After Tax (Column 3 minus 4)	(6) Accumulation (Column 6)
1	$4,000	$.....	$4,000	$2,000	$2,000	$2,000
2	4,000	80	4,080	2,040	2,040	4,040
3	4,000	162	4,162	2,081	2,081	6,121
4	4,000	245	4,245	2,123	2,122	8,243
5	4,000	330	4,330	2,165	2,165	10,408
6	4,000	416	4,416	2,208	2,208	12,616
7	4,000	505	4,505	2,253	2,252	14,868
8	4,000	595	4,595	2,298	2,297	17,165
9	4,000	687	4,687	2,344	2,343	19,508
10	4,000	780	4,780	2,390	2,390	21,898
Totals:	$40,000	$3,800	$43,800	$21,902	$21,898	

TABLE III—COMPARISON

Year	With Trust	Without Trust $75,000	$60,000	$40,000	$30,000
1	$3,193	$1,400	$1,520	$1,880	$2,200
2	6,485	2,820	3,063	3,793	4,447
3	9,876	4,260	4,630	5,740	6,741
4	13,368	5,719	6,220	7,721	9,085
5	16,963	7,199	7,835	9,737	11,477
6	20,664	8,700	9,474	11,788	13,920
7	24,474	10,222	11,138	13,876	16,415
8	28,398	11,765	12,827	16,000	18,963
9	32,438	13,330	14,542	18,162	21,565
10	36,598	14,917	16,283	20,361	24,222

of the trust, we see that at the end of the tenth year, the trust has accumulated $36,598 which the Trustee will then distribute *tax free* to George's wife, and George will get back his stock. If George had not created the trust, but had continued to receive the $4,000 of dividends each year in his 50% tax bracket, even assuming he had reinvested his after-tax dollars at 4%, he would only have $21,898 left after taxes at the end of the ten years. By creating the trust, George has made for his family $14,700 in after-tax dollars. He would have had to earn at least $29,400—nearly one year's income from his business—to have netted that same amount in after-tax dollars.

George has earned for his family the equivalent of almost $30,000 by creating the trust for his wife. What they do with the money is unimportant for our purposes; whether they take a trip to Europe, make a down payment on a new home or send the kids to college doesn't matter. What does matter is that they will have $14,700 more spendable, after-tax dollars than they otherwise would have had without creating the trust.

BIG SMILE on the face of electrical contractor John Lambert (left) is understandable, inasmuch as he is pictured here "getting the word" about winning a trip-for-two to our 50th State. On the other end of the congratulatory handshake is Bob Broostrom, residential sales rep for the Portland (Ore.) General Electric Co., sponsor of this plus two additional Hawaiian trips being presented to northwestern contractors as part of a huge Gold Medallion promotion campaign. To be eligible for the award, contractors had to attend a PGE Medallion Home Workshop, then wire at least one approved Medallion Home. A card related to each completed home was then dropped in "the barrel" for periodic drawings.

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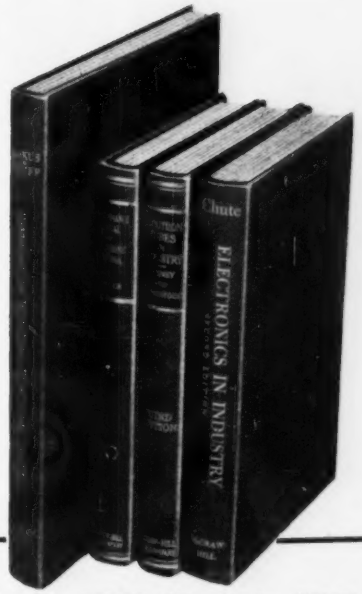

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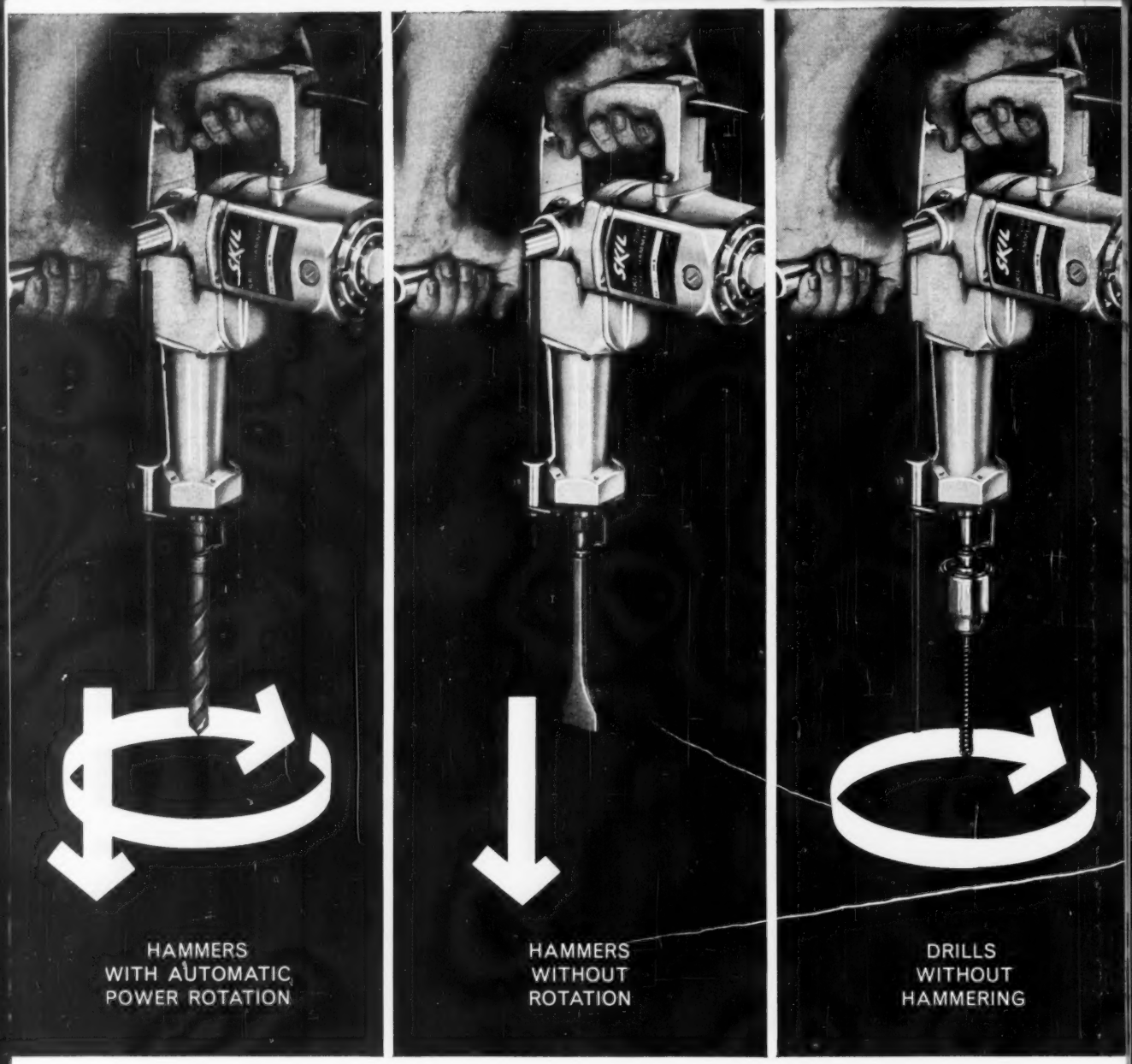

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$80.14 (labor & bit)	$337.20 (labor & bits)
8¢ per hole	34¢ per hole

*New SKIL Carbide Bits stay sharp 20 to 30 times longer than star drills.

SKIL . . . and SKILSAW POWER TOOLS

Electricity Sparks The Sixties

The electrical industry, a bulwark of the nation's economy and an accurate barometer of "financial weather" ahead, begins the 1960's with employment at a 3,000,000-plus peak, and drawing boards crammed with new product ideas to match the far-reaching needs of what promises to be a "fabulous decade of opportunity and achievement."

All branches of this vast, multi-billion dollar industry will enter the new decade under the banner—"Electricity Sparks the '60s." The slogan will be officially recognized during National Electrical Week—February 7-13 — when such branches of America's electrical industry as electric power suppliers, manufacturers, electrical contractors, distributors, retailers, service and repair shops and communications companies observe the birthday anniversary of Thomas A. Edison. Mr. Edison is typical of early pioneer inventors whose collective genius helped to create and build the industry from an electric light to its present vast size and scope.

National Electrical Week is conducted as an umbrella activity for all branches of the electrical industry, according to N. J. MacDonald, chairman of the observance and president of The Thomas & Betts Company of Elizabeth, N. J. It is a "stage," he added, upon which each company and electrical trade organization can produce its own programs and direct its efforts toward its own special audience or the country at large.

In a review of present conditions and a look-ahead into the future, Mr. MacDonald, speaking for the Industry Committee on National Electrical Week, reported:

"Business throughout the electrical industry was generally satisfactory in 1959 despite strikes and some soft spots in the employment picture. Another good year is in prospect for 1960.

"As for the more distant future, we are optimistic and see consumer spending climbing to about $490 billion by 1960 with sales of new products—still in the research stage—leading the purchasing parade."

A round-up of information from engineering, marketing and sales sources in the electrical industry, as given by the NEW Committee, presents a picture of "things to come" that staggers the imagination.

Here, for example, is industry's "startling forecast" of what it will offer the public during the next decade.

A typical home will be totally electric, built around an automatic pushbutton control center which adjusts the temperature and humidity of the house to meet any change in weather conditions, and enables the family to obtain the precise level and color combination of lighting desired for any room.

The housewife may buy an entire week's supply of food in 21 pre-packaged cartons, selected from more than 100 menus available at the shopping market. Preparation of a complete meal can be accomplished by pushing a button to convey the proper carton automatically from the home freezer to the electronic cooking station. Food will be cooked exactly as desired without human effort of any kind.

Compact thermoelectric refrigerators or thermoelectric refrigerated drawers will replace present type refrigerators. By reversing the flow of current, the user of a a thermoelectric unit will be able to convert his refrigerator into an oven.

The future also holds a hostess cart that heats and cools with electricity; an ultrasonic sink that washes dishes by means of sound waves, electric blankets that both heat and cool. Dusting will be done with an electro-static wand. Prepackaged bedroom units will provide automatic clothes cleaners. Laundro-closets will carry soiled clothing through wash, rinse and dry chambers . . . and return the clothing to a conventional closet ready to wear.

Home lighting is advancing rapidly and the present trend now is to provide light for seeing tasks, light to bring out the maximum beauty of color, texture and design of home furnishings, to protect people from accidents and to make the home atmosphere far superior for the numerous activities that take place in the home. The industry predicts that this trend will increase in the '60s with the ultimate result being the installation of luminous panel walls and ceilings.

Television sets will probably make use of a principle known as "light amplification." Instead of a large picture tube in a bulky cabinet, thin TV screens will be located on walls of various rooms . . . and the programs, of course, will be in color.

See Increase in Use of Electricity

The tremendous increased use of present and "still-to-come" electric equipment will mean a sharp upward turn in the consumption of electric power both in homes and in industry.

Estimates of total electric power usage in future years vary, but the publisher of one of the industry's leading trade journals predicts that total electric energy sales over the next decade will increase by 120% —which is equivalent to adding 745 billion kilowatthours to the present electrical load. Of this total increase, he estimates that 331 billion kwhr will come from industrial use, 157 billion kwhr from commercial customers, and 234 billion kwhr from residential customers. The remaining 23 billion kwhr of electricity will be used on the farm, for street and highway lighting, and for a variety of other purposes.

Electrical Construction Hits $10.2 Billion

In 1960 the value of electrical construction put into place in all type of new and modernized and repair buildings and facilities will exceed $10.2 billion. This covers the cost of electrical construction materials and labor and engineering involved. This is 12% of the anticipated total outlay for construction, the nation's largest single economic activity, of $85 billion (new, modernized and maintenance construction) for 1960. In 1950 the electrical part of the dollar spent for construction was only 4.6%. By 1956 this had moved up to 9.4%. In 1960 it will be 12% and will continue to grow as electric heating and automation gains in popularity.

In dollars, one executive estimates that total major appliance business will about double over the next 10 years with all firms doing approximately $3,200,000,000. The portable appliance business will zoom to $800,000,000; room air conditioner business, to $479,000,000, and television receiver business to $810,000,000.

Man Hours to Kilowatt Hours

Emphasis is rapidly shifting from man hours to kilowatt hours to meet the production requirements of our expanding economy. As a result total power generation by the utility industry could well approach the 1.5 trillion kilowatt-hour mark by 1969. At present this mark is more than 700 billion kilowatthours.

With about one out of every 20 non-agricultural workers employed by the electrical industry, it is reasonable to assume, said Mr. MacDonald, that America's standard of living today and in the coming years is dependent almost directly on the continued progress made in applying generous quantities of electricity to the tools and equipment used "in every facet of our residential, commercial and industrial ways of life." This "electrifying view of the future" gives added impetus and importance to 1960's observance of National Electrical Week, Mr. MacDonald concluded.

MEA Estimating School A Success

On November 21, 42 members of the Minnesota Electrical Association completed a full two-day course on electrical estimating and accounting. There would have been many more, but registration was limited to two classes of 21 "students" each so instructors could offer practical "working" sessions with more assistance and attention to the individual.

Textbooks for the school were the new MEA Estimating and Accounting Manual and the 1959 National Electrical Code. Course program and materials were developed under the guidance of the faculty of the Dunwoody Industrial Institute in Minneapolis where classes were held. The contractor committee in charge of the school included: Chairman Elroy Lehn, Anoka; Gene Burton Brainerd; Melvin Gordon, Albert Lea; and consultant Norman DeYoung of St. Paul.

MEA manager Harry W. Kane reports the school was so successful that several more sessions are being planned for 1960. While this course was limited to member registrants, those in the future may be opened non-member interested parties.

NISA News

More than 58 persons affiliated with NISA attended the 2nd National Conference on the Application of Electrical Insulation in Washington, D. C., December 8-10. A NISA exhibit featured color photographs of unusual insulation jobs performed by member shops. Staff engineers C. H. Lankford and A. C. Roe were on hand to answer questions about insulation abilities of independent electrical apparatus service shops.

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Christmas parties dominated the NISA December scene. At Milford, Conn., members of Connecticut Chapter enjoyed themselves at Do-Nut-Ho Towne House Inn. Mike Smaga was party chairman. Great Lakes Chapter celebrated on December 10 at Hawthorne Valley Golf Club, Red Watterson in charge, with Chris Palmer, Joseph Bilicki, Walter Heebe and Harry Kerr assisting. In Philadelphia, Mrs. Ralph Kufen took over arrangements for the Quaker City Chapter Christmas party, held December 5 at Beck's Restaurant. In Boston, New England Chapter celebrated the holiday season with a party December 10. St. Louis Chapter held their annual party December 13.

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L. Kowal, Metals and Controls Corp., Attleboro, Mass., addressed the Cincinnati Chapter of NISA on December 2, describing ways of using Klixon brand motor protectors.

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Dynamic balancing was the topic discussed by speaker Ralph T. Buscarello, of Eugene Roth, Inc., at the November 19 meeting of New York Chapter, held at Hotel Shelburne.

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New members of NISA's Southwestern Chapter include: Sheppard-Mamers Electric Co., San Antonio, Texas; United Electric & Magneto Service, Alexandria, La.; and Dissen Electrical Works, Houston, Texas. The chapter's next meeting will be held in Dallas, March 10-12.

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A large delegation from New York Chapter will be among the electrical apparatus service firms personnel attending a special meeting of Quaker City Chapter January 27 during the 11th Annual Plant Maintenance & Engineering Show, Philadelphia, January 25-28. NISA President Horace C. Blenkhorn will be one of the principal speakers.

Acme Electric Corp., Cuba, N. Y., was host to members of Niagara Chapter on Nov. 6. A reception and dinner preceded a plant tour. Joseph Hupp, dry-type transformer manager, discussed product trends, and Chapter president Al Volland reported on the NISA Chapter Officers Conference held last September in St. Louis.

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"Motors in the Making" was the title of a film shown to members of Wisconsin Chapter by Ralph Warren and Charles Low of Wagner Electric Corp. at a meeting in Germantown on November 17.

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Jay Almerico, Avena Motors; Joseph Ferrari, Excel Electric Service; Glenn Glave, Chicago Electric Co.; Abe Marcus, Ther Electric & Machine Works; and Sig Pluskota, moderator, comprised a panel at the December 8 meeting of Chicago Chapter. They led a discussion of cost and pricing methods for rebuilding, rewinding, trouble shooting and manufacturing.

New Books

Theory and Design of Small Induction Motors, by Cyril G. Veinott. 492 pages; $13.50. McGraw-Hill Book Co., 327 W. 41st St., New York 36, N. Y.

A comprehensive coverage of the engineering, application, and design procedures that must be taken into account when working with small induction motors. Organized in four parts for easy reference, the book describes engineering principles and characteristics; treats theory and performance calculation methods; provides means and formulas for analyzing a given design; and shows how to design a machine to meet specified objectives. Main emphasis is on the basic theory; mathematics is used only as needed to explain methods and develop formulas.

Principles of Alternating Currents, by W. Sluckin & J. R. Greener, Second Edition. 338 pages; $2.40 postpaid. Cleaver-Hume Press Ltd., 31 Wright's Lane, London W8, England.

A practical approach to ac circuits and apparatus. After discussing the nature of electricity and alternating currents in general, this book covers vector representation and types of ac circuits; operation of single and polyphase systems; principles and operation of transformers; power transmis-

sion and distribution; power factor improvement; and ac measurements. Special coverage is included on electronic principles and their application to power work, plus a discussion of typical utilizing apparatus such as induction and dielectric heating equipment and electric discharge lighting. Test questions and answers are included for self-study.

Connecting Induction Motors: Operation and Practice, by A. M. Dudley and Samuel F. Henderson. Fourth Edition; 425 pages; $13.50. McGraw-Hill Book Co., 327 W. 41st St., New York 36, N. Y.

New revision presents up-to-date data on operation and repair of both single and polyphase induction motors plus new chapters on part-winding starting connections, single-phase connections, multi-speed polyphase motors, and use of motor nameplate data.

Electric Traction Engineering, by E. A. Binney. 224 pages; $2.50 postpaid. Cleaver-Hume Press Ltd., 31 Wright's Lane, London W8, England.

A unique book devoted exclusively to the highly specialized application of electricity to electric railways and transit vehicles. The exacting limitations encountered in the field demand specially designed apparatus and circuiting. This book applies basic electrical fundamentals to the solutions of these problems, with complete explanations of various traction systems in use, traction motors, diesel-electric generators, mechanical drives, and control.

Switchgear Principles, by P. H. G. Crane. 238 pages; $3.75 postpaid. Cleaver-Hume Press Ltd., 31 Wright's Lane, London W8, England.

A basic reference covering all aspects of the subject from bushings to cubicles. Chapters treat transmission and distribution systems, short circuits and overvoltages, electrical discharges, principles of circuit-breaking, oil and air breakers, switchgear types and components, and tests and specifications.

Construction Accounting and Financial Management, by W. E. Coombs; 490 pages, $12.85. F. W. Dodge Corp., 119 West 40th St., New York 18, N. Y.

A complete treatment of accounting and management procedures for contractors with practical details directly applicable to job and cost controls.

DATES AHEAD

National Association of Home Builders—16th annual convention and exposition, Conrad Hilton, Hotel Sherman, Chicago Coliseum, Chicago, Ill., January 17-21, 1960.

Industrial Heating Equipment Assn.—Annual winter meeting, Warwick Hotel, Philadelphia, Pa., January 18-19.

International Association of Electrical Inspectors—Kentucky Chapter, Kentucky Hotel, Louisville, Ky., January 21-22; Virginia Chapter, Mariner Hotel, North Virginia Beach, Va., April 4-5.

Plant Maintenance & Engineering Show—Convention Hall, Philadelphia, Pa., January 25-28.

American Institute of Electrical Engineers—Winter general meeting, New York, N. Y., January 31-February 5.

National Industrial Electric Heating Conference—Netherland-Hilton Hotel, Cincinnati, Ohio, February 1-4.

National Electrical Week—National Promotion, February 7-13.

National Electrical Week Luncheon—Sheraton-Astor Hotel, New York, N. Y., February 9.

Power and Communication Contractors Assn.—15th annual convention, Brown Palace Hotel, Denver, Colo., February 14-16.

Upper Midwest Electric Industry Convention—Leamington Hotel and Municipal Auditorium, Minneapolis, Minn., February 14-17.

National Rural Electric Co-op. Assn.—18th annual meeting, Kiel Auditorium, St. Louis, Mo., February 22-25.

16th Annual National Wiring Sales Conference—Warwick Hotel, Philadelphia, Pa., February 25-26.

5th National Electrical Industries Show—New York Coliseum, New York, N. Y., March 6-9.

Electrical Maintenance Engineers Assn. of California—10th Biennial Electrical industry show, Shrine Exposition Hall, Los Angeles, Calif., March 23-26.

American Power Conference—Sherman Hotel, Chicago, Ill., March 29-31.

Electrical Living Show, Milwaukee Home Show, Milwaukee Arena, Milwaukee, Wis., April 2-10.

Edison Electric Institute—Sales Conference, Edgewater Beach Hotel, Chicago, Ill., April 4-6.

1960 Electrical Show for Industry—Cleveland Public Hall, Cleveland, Ohio, April 5-7.

Maintenance and Plant Engineering Conference—Chase-Park Plaza, St. Louis, Mo., April 25-26.

National Association of Electrical Distributors—Annual convention, Dallas, Texas, May 1-5.

National Industrial Service Assn., Inc.—Annual convention, Hotel Fontainebleau, Miami Beach, Fla., May 4-7.

National Fire Protection Assn.—Annual meeting, Montreal, Canada, May 16-20.

Pacific Coast Electrical Assn.—Annual convention, Stardust Hotel, Las Vegas, Nev., May 16-18.

Design Engineering Conference and Show—Statler-Hilton and Coliseum, New York, N. Y., May 23-26.

Edison Electric Institute—Annual Convention, Atlantic City, N. J., June 6-8.

New York State Associaiton of Electrical Contractors & Dealers—61st annual convention, Whiteface Inn, Lake Placid, N. Y., July 3-8.

National Association of Lighting Maintenance Contractors—National conference, Milwaukee Inn, Milwaukee, Wis., August 22-24.

Illuminating Engineering Society—National Technical Conference, Penn-Sheraton Hotel, Pittsburgh, Pa., September 11-16.

International Association of Electrical Inspectors — Northwest Section, Portland, Ore., September 12-14; Southwest Section, Reno, Nev., September 19-21; Eastern Section, September 26-28; Western Section, Continental Hotel, Kansas City, Mo., October 3-5; Canadian Section, Toronto, Ont., Canada, October 8-9; Southern Section, Rice Hotel, Houston, Texas, October 17-19.

Pennsylvania Electric Assn.—53d annual meeting, Penn-Sheraton, Pittsburgh, Pa., September 20-22.

International Association of Electrical Leagues—25th annual conference, Hotel President, Kansas City, Mo., October 5-7.

National Electronics Conference—Hotel Sherman, Chicago, Ill., October 10-12.

National Electrical Contractors Association—1960 annual convention, Las Vegas Convention Center, Las Vegas, Nev., October 23-27.

National Electrical Manufacturers Assn.—Annual meeting, Traymore Hotel, Atlantic City, N. J., November 14-18.

Electrical & Home Appliance Show—Electrical Building, Balboa Park, San Diego, Calif., November 25-30.

Among the Manufacturers

Headquarters Announcements

Revere Electric Mfg. Co., Niles, Ill., has purchased the **Hutchinson Mfg. Co.,** Houston, Tex., maker of derrick lighting systems.

I-T-E Circuit Breaker Co., Philadelphia, Pa.—Alfred G. Bosanko, vice president, indoor distribution.

Emerson Electric Mfg. Co., St. Louis, Mo.—Bernard Purcell, assistant vice president in charge of operations and general manufacturing manager.

BullDog Electric Products Div., I-T-E Circuit Breaker Co., Detroit, Mich.—Philip Scharf, Jr., promotion manager, panelboards and switchboards.

General Electric Co., Schenectady, N. Y.—Charles J. Meloun, manager of marketing, Outdoor Lighting Dept.; James L. Richardson, advertising and sales promotion manager, Distribution Transformer Dept.

Paragon Electric Co., Two Rivers, Wis.—Howard M. Buchholz, manager, Commercial Time Switch Div.

Executone, Inc., New York, N. Y.—Frederick Zissu and Richard I. Palmer, new directors.

Smithcraft Corp., Chelsea, Mass.—Austin H. Leach, superintendent, manufacturing; Edward H. Bernstein, manager of employee relations.

Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.—Douglas K. Ridley, contract sales manager for automatic control equipment.

Daystrom, Inc., Murray Hill, N. J.—Charles D. Manhart, vice president.

Appleton Electric Co., Chicago, Ill.—Chester B. Hudgins, manager of systems planning and controls; H. B. Paxton, vice president in charge of finance.

Day-Brite Lighting, Inc., St. Louis, Mo.—Earl N. Picker, sales promotion manager.

Triangle Conduit & Cable Co., New Brunswick, N. J.—Glenn J. McMahon, plant manager, Conduit and Armored Cable Div.

Thomas Industries Inc., Louisville, Ky.—Charles W. Cassidy, director of industrial relations.

Corning Glass Works, Corning, N. Y.—Joseph S. DeMaio, advertising and sales promotion manager, Electrical Products Div.

Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Derio Dalasta, head

HAROLD GERBER, senior electrical engineer for the Coddington Company, San Francisco, checks branch wiring in rural school where special ballasts were designed to permit lighting at 208 volts.

of new static relay section, Switchgear Dept.

Regional Appointments

NEW ENGLAND

Electric Distribution Products, Inc.: Baynes, Inc., representative in Hartford, Conn.

Allis-Chalmers Mfg. Co.: S. M. Osthagen, manager of utility sales, and C. R. Carlisle, manager of industrial sales, Boston district.

MIDDLE ATLANTIC

Preformed Line Products Co.: Fred J. Lekson, district manager of sales, eastern area.

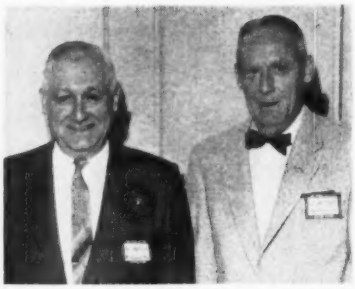
Electric Distribution Products, Inc.: Jones Associates, representatives in Jersey City, N. J.; Porter Electrical Mfg. Co., representatives in Murrysville, Pa.

Sun-Tron Corp.: Robert B. Mugridge, Neptune, N. J., representative in northern New Jersey; A. Weingarten Corp., representative in southern New Jersey, Delaware and western Pennsylvania.

SOUTH ATLANTIC

Electric Distribution Products, Inc.: Robert S. Fishburne, representative in Richmond, Va.; R. W. Chapman, representative in Charlotte, N. C.; South East Engineering Services, Inc., representatives in South Jacksonville, Fla.

Sun-Tron Corp.: New representatives: Bucky Moore, Myrtle Beach, S. C., covering South Carolina; Ken H. Hill, Mount Dora, Fla., covering Florida; Kuzell and Co., Decatur, Ga., covering Georgia; Robert C. Chapman, Charlotte, N. C., covering North Carolina.



ACTIVE PARTICIPANTS in the 35th annual meeting of the eastern section of IAEI at Spring Lake, N. J., included (L-R): C. L. Kelly, Sr., chief inspector, Bridgeport, Conn., and G. J. Bostley, Rensselaer, N. Y., new president of the eastern section for 1960.

EAST CENTRAL

Okonite Company: Edward C. Brass, manager, Cleveland office.

Pennsylvania Transformer Div., McGraw-Edison Co.: Edmond P. Zimsky, manager, new sales office in Chattanooga, Tenn.

Sun-Tron Corp.; C. W. Bates, Detroit, Mich., representative in Michigan; General Sales Co., Indianapolis, Ind., representative in Indiana and Kentucky.

Advance Transformer Co.: Jerry Gatz, representative in Ohio, Pittsburgh and West Virginia.

Electric Distribution Products, Inc.: Gregory-Salisbury & Co., representative in Louisiana, Mississippi, Tennessee, Alabama and Arkansas; Webco, Inc., representative in Detroit, Mich.; John M. Perry Co., representative in Grand Rapids, Mich.

Allis-Chalmers Mfg. Co.: Robert C. Brown, manager, General Products Div. sales, Midwest region.

WEST CENTRAL

Sun-Tron Corp.: Hodges Co., Dallas, Tex., representative in Texas and Oklahoma; C. F. Thomas, St. Louis, Mo., representative covering Arkansas, Central and South Illinois, and Missouri.

Electric Distribution Products, Inc.: Powell Electrical Mfg. Co., representative in Houston, Tex.; R. L. Browne Co., representative in Shawnee, Kans.; Chuck Koerner, representative in St. Louis, Mo.

WEST

Advance Transformer Co.: Reese Gwillim, representative in northern California.

Preformed Line Products Co.: Kenneth R. Miller, district manager of sales, western area.

CAN YOU SELECT THE BETTER CONTRACTS?

(FROM PAGE 89)

work that his existing contracts will suffer through a dilution or shift of mechanics and equipment to service the added projects.

Future Business. Work that seems to be of the nuisance type often turns out to be a real asset. It may establish connections which lead to valuable business in the future. Repair work is often placed in this category, but many contractors do it to establish and maintain good customer relations.

One may have difficulty in selling the relatively high-priced service involved in repair work. Although the ratio of material to labor is low and operating costs are high, often it is hard to convince customers that the required markups are just. Contractors frequently have to absorb some of the cost of repair work to avoid antagonizing customers.

Fig. 2 presents the operating costs for supplying repair services. Although the study was made several years ago, the percentages noted are still representative and the cost figures have been revised to reflect present conditions.

The General Contractor. Some general contractors expedite their work better than others and all of the sub trades benefit. On many jobs the cost of roughing-in work may vary as much as 10%, depending on the firm handling the general contract. We hear much about the abuses of the general contractors. Most of us know that the sub trades invite a good part of this.

The Architect. Before appraising the value of contracts an architect may be in a position to let, the electrical contractor must settle a few questions regarding said architect. The following three are important:

1. How well are his jobs engineered?
2. Which general contractor is he likely to use?
3. How well does he expedite his work?

Answers to these will help the contractor decide if the work is of a desirable nature. Also, before soliciting an architect's business, the electrical contractor should learn whether or not the architect will give him favorable consideration.

Any job is a good one if it will yield a return commensurate with time and services invested. Bear this in mind for all projects.

Advertising In This Issue

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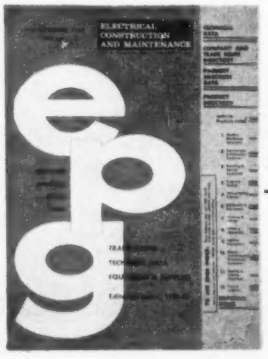
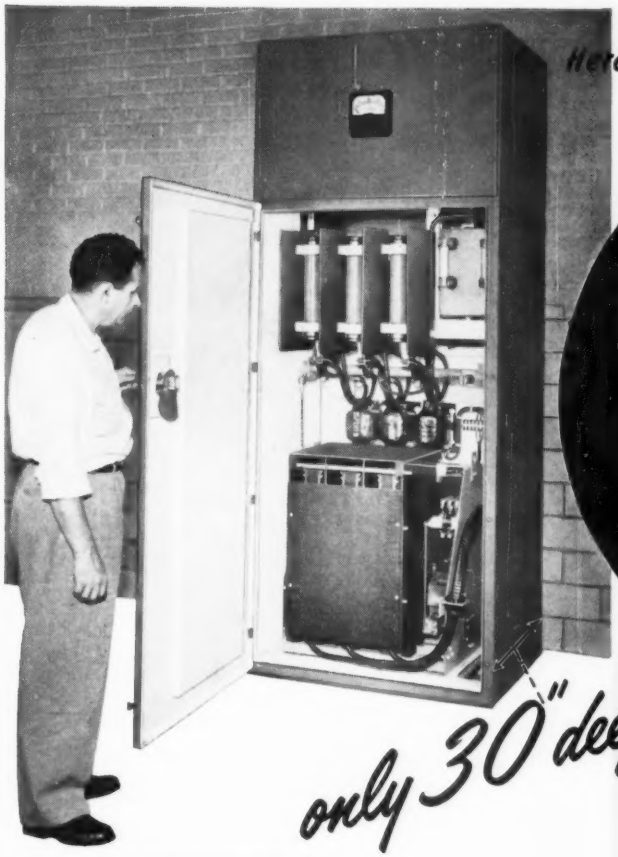
CLASSIFIED ADVERTISING
F. J. Eberle, Business Mgr.



• These manufacturers advertised their products in the ELECTRICAL PRODUCTS GUIDE ISSUE

For more complete information, and application data on their lines, refer to the index of Advertisers in the ELECTRICAL PRODUCTS GUIDE . . . the 13th issue of ELECTRICAL CONSTRUCTION AND MAINTENANCE.

Here is **DESIGN LEADERSHIP** *...in Action!*



3-way Padlock Protection WITH EC&M Air-Break High Voltage (2200-4800 VOLTS) Starters

only 30" deep!

Accessible from Front...

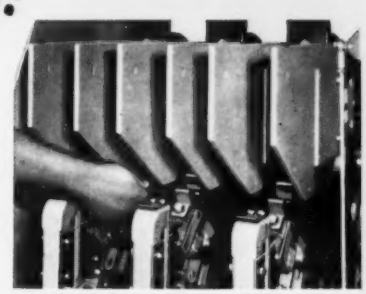
(Solid back) • Starters may be mounted against wall or in double row, back to back

EC&M's door-and-disconnect interlocking system gives you 3-way padlocked safety. The gang-operated Disconnect Switch may be padlocked (**1**) in the "ON" position or (**2**) in the "OFF" position—both with the starter door closed. (**3**) The door opens only by backing out captive thumb screws after the contactor and disconnect are open. For COMPLETE SAFETY—Disconnect Switch blades engage grounding clips in the open position.

EC&M's simple interference interlock permits manual operation of the contactor to check contact alignment, shaft rotation, and electrical interlock engagement. No roll-out is needed for any maintenance—contacts, operating coil, and control contacts are fully accessible within the enclosure.

EC&M starters are furnished with a control transformer. Since the bus is located in an isolated upper compartment, only one feeder is required for a group of starters.

Write for **BULLETIN 8130**



NO DRAW-OUT NEEDED • Arc shields slide out horizontally, making front and rear contact-tips removable with standard wrench.

3 Interrupting Ratings for Squirrel Cage, Synchronous and Wound-rotor Motors

1. **CLASS E 1** • 50,000 KVA (symmetrical) based on certified tests.
2. **CLASS E 2** • With current limiting fuses and high interrupting capacity contactor. At 2300 volts: 150,000 KVA, 3 phase; 60,000 RMS amperes asymmetrical. At 4,800 volts: 250,000 KVA, 3 phase; 60,000 RMS amperes asymmetrical.
3. **VALIMITOR®** • May be used on a bus of unlimited short circuit capacity, through the use of a contactor with an interrupting rating of 50,000 KVA, and reactors which limit any fault current to a maximum of 25,000 KVA.

SQUARE D COMPANY

EC&M DIVISION • CLEVELAND 28, OHIO

wherever electricity is distributed and controlled

7955-R

NOW a single Condulet® for any make motor starter and circuit breaker!

CROUSE-HINDS TYPES DMC* AND WMC** Combination Line Starter CONDULETS

DMC-WMC Condulets are designed to accept and operate any of the various makes of motor starters and circuit breakers. Single speed non-reversing combinations are equipped with a universal mounting plate, motor starter reset assembly and circuit breaker operating assembly. No substitutions of any parts on the Condulets are required.

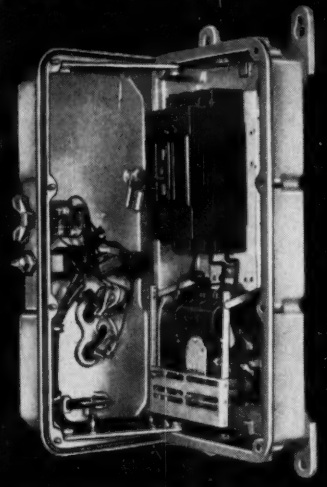
Built-in push-button stations and selector switches with various contact arrangements, pilot lights and control transformers can be supplied. Push-button and selector-switch operating shaft holes and pilot-light holes may be drilled, tapped and plugged for future use.

Separate mounting lugs are bolted on body. A center position is provided on back of body so that lugs can be attached for 3 point suspension or center pole (2 point) mounting. Circuit breaker handle has provision for padlocking in "On" or "Off" position.

WRITE for descriptive literature and specifications . . . or contact your Crouse-Hinds distributor.

*TYPE DMC: Dust-Ignition-Proof (Dust-Tight) — National Electrical Code Class II, Groups E, F and G; NEMA Type 9EFG.

**TYPE WMC: Watertight — NEMA Types 3, 3R, 4 and 5.



UNIQUE COVER HINGING ARRANGEMENT allows DMC-WMC Condulets to be mounted directly adjacent to other Condulets without providing extra space between for cover to hinge open. Cover pulls out, then to *either* side to clear adjacently-mounted Condulets or other equipment.

CROUSE HINDS

MAIN OFFICE AND FACTORY: SYRACUSE, NEW YORK

Crouse-Hinds Company of Canada, Ltd., Toronto, Ont.
Crouse-Hinds Instrument Company, Inc., Silver Spring, Maryland

● CONDULET® ELECTRICAL EQUIPMENT (Explosion-Proof and Conventional) ● FLOODLIGHTING
● TRAFFIC CONTROL SYSTEMS ● AIRPORT LIGHTING and WEATHER MEASURING EQUIPMENT

These products are sold exclusively through electrical distributors. For application engineering help, contact one of the following offices: Atlanta Baton Rouge Birmingham Boston Buffalo Charlotte Chicago Cincinnati Cleveland Corpus Christi Dallas Denver Detroit Houston Indianapolis Kansas City Los Angeles Milwaukee New Orleans New York Omaha Philadelphia Pittsburgh Portland, Ore. St. Louis St. Paul Salt Lake City San Francisco Seattle Tulsa Washington

Resident Representatives: Albany Baltimore Reading, Pa. Richmond, Va.